JOURNAL OF THE
BOSTON SOCIETY
OF
CIVIL ENGINEERS

DECEMBER, 1928

Featuring

Reconstruction of
Vermont Highways

Atlantic City Convention
Hall

Vol. XV No. 10

BOSTON SOCIETY OF CIVIL ENGINEERS

OFFICERS, 1928-1929

PRESIDENT
CHARLES B. BREED

VICE-PRESIDENTS
LEWIS E. MOORE
(Term expires March, 1929)
ARTHUR T. SAFFORD
(Term expires March, 1930)

SECRETARY AND LIBRARIAN
JOHN B. BABCOCK, 3d

TREASURER
FRANK O. WHITNEY

DIRECTORS
HARRISON P. EDDY, Jr.
FRANK C. SHEPHERD
(Term expires March, 1929)
EDWARD H. CAMERON
RALPH W. HORNE
(Term expires March, 1930)

PAST PRESIDENTS
(Members of the Board)
RICHARD K. HALE
CHARLES M. ALLEN
FRANK A. MARSTON

SANITARY SECTION
RALPH W. HORNE, Chairman
STUART E. COBURN, Clerk

DESIGNERS SECTION
WM. D. HENDERSON, Chairman
NORMAN P. RANDLETT, Clerk

HIGHWAY SECTION
LE ROY M. HERSUM, Chairman
ERNEST MATHERS, Clerk

NORTHEASTERN UNIVERSITY SECTION
HAROLD L. BURTON, Chairman
KENNETH D. SYLVESTER, Clerk

Editor — WALDO F. PIKE
715 Tremont Temple, Boston

JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS

Volume XV DECEMBER, 1928 Number 10

CONTENTS

PAPERS AND DISCUSSIONS

PAGE

Reconstruction of Vermont Highways:

Stoddard B. Bates 449
Hubert E. Sargent 451
A. J. Runnals 453
A. D. Bishop 456
H. K. Barrows 461
William F. Williams 464
Design and Construction of the Atlantic City Convention Hall. *Samuel L. Ware* 467

OF GENERAL INTEREST

Flood Flows in New England in November, 1927 474
Hoover is Elected 479
Inspection of Boston Garden 480

Memoir:

Sturgis Hooper Thorndike 481
Proceedings of the Society 483

CONTENTS AND INDEX—Volume XV, 1928

Contents iii
Index vii

Published Monthly, except July and August, by the Society
715 Tremont Temple, Boston, Massachusetts

Subscription Price, $4.00 a Year (10 Copies)
50 Cents a Copy

Copyright, 1928, by the Boston Society of Civil Engineers.

Entered as second-class matter, January 15, 1914, at the Post Office
at Boston, Mass., under Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 16, 1918.

The Society is not responsible for any statement made or opinion expressed in its publications.

BOSTON
WRIGHT & POTTER PRINTING COMPANY
32 DERNE STREET

JOURNAL OF THE

BOSTON SOCIETY OF CIVIL ENGINEERS

Volume XV DECEMBER, 1928 Number 10

RECONSTRUCTION OF VERMONT HIGHWAYS

(Papers and discussions presented at a joint meeting of the Designers and Highway Sections, Boston Society of Civil Engineers, October 10, 1928)

STODDARD B. BATES.* — The State of Vermont is 95 miles wide on the north end and 45 miles wide on the south end. Two counties border the Massachusetts line and four counties border the Canadian line. After the flood there was practically no damage in Grand Isle County, in the northwestern corner of the State. In Essex County, in the northeastern corner of the State, there was $28,000 damage. This refers, of course, only to damage to highways and bridges, and not to other losses occasioned by the flood.

There are in the State two United States Weather Bureaus, one at Burlington on the west, and one at Northfield in the center. The Weather Bureau at Burlington reported a fall of 5.62 inches in forty-seven hours. The Weather Bureau at Northfield showed a fall of 8.63 inches in forty-two hours. There were 3 inches more in the center of the State, showing that the storm went down the center of the State.

Immediately after the flood the District Highway Commissioners were asked to investigate conditions and make an estimate of the damage and report as to cost of replacement of highways and bridges injured by the flood. They estimated the cost of replacement of bridges at $4,579,082 and $2,483,916 for roads.

There are 32 principal rivers in Vermont. While bridges and culverts on small streams were lost, most of the damage was on these rivers. On the White River, which is one of our largest and empties into the Connecticut, the damage was a little over $1,500,000. On the

---

* Commissioner of Highways, State Highway Board, Montpelier, Vermont.

Winooski River, which empties into Lake Champlain, the damage was over $1,000,000. There were 1,214 bridges damaged or destroyed as reported by the District Highway Commissioners. According to the Vermont statute any structure over 4 feet in span is designated as a bridge. Most of the bridges were of considerably longer span. The report showed that some were of fairly good size. There were 9 over 200 feet span, 11 over 150 feet, 27 between 100 and 150 feet.

Vermont retains a town system, and the towns are responsible for the highways. Under the law certain roads are selected on which the State aids the towns in construction and maintenance. Under the Federal Aid Law, which provides that 7 per cent of the roads may be selected as Federal aid roads, 1,043 miles are designated as Federal aid roads. The Bureau of Public Roads on request made an inspection and detailed estimate of the damage done, and reported a total damage of $7,377,469, this being the replacement cost of modern construction. When the Governor and the Highway Department considered the matter they decided that the question of replacement was not so much a mere question of reconstruction as of building something that would meet present conditions. The Governor called the Legislature together in special session, and they appropriated $8,000,000 for the payment of expenses of repairs and replacements already made, the construction and maintenance of temporary highways and bridges, and for aid to all municipalities to the full extent of their damage to public highways and bridges.

Two years ago a traffic survey was taken in connection with the Federal Government and a road program was proposed in which it was recommended that all roads carrying over 800 cars a day should be constructed with surface superior to gravel. When the matter of flood reconstruction was studied it was decided that the roads should be rebuilt not only as permanent as possible, but with a surface as recommended for the first five-year program. In the construction of bridges under the State Aid Law it has been the policy to construct them with a 21-foot roadway and a capacity to carry 15-ton traffic. In reconstruction on the State aid roads this plan is being followed.

The Federal Government appropriated $2,654,000 to assist the State of Vermont in the reconstruction of highways and bridges in the flooded area, and provided that the money should be used to give as much permanent relief as possible. This, of course, did not mean to rebuild the old covered bridges, but to build modern bridges to meet conditions of present traffic, and also improve such highways carrying 800 cars as was planned to build in the next five years. So the main roads that were destroyed by the flood are now being made of standard capacity, and many of them are being paved with concrete and more are being planned for next year. The result will be that a good many miles of road which were practically destroyed this past year, when fully reconstructed will be much better than ever before. While it is with sorrow that we think of the destruction, as far as the road program is concerned we shall be further ahead in the next five years than we would have been if we had not had the flood.

HUBERT E. SARGENT.* — Vermont is a small State and ordinarily our activities are not of great magnitude as compared with some other States, but since the flood our work has been increased many times. Most of the work is being taken care of this year. Last year we built 48 miles of hard-surfaced roads and also about 100 bridges with State aid, and about 15 on the Federal aid system.

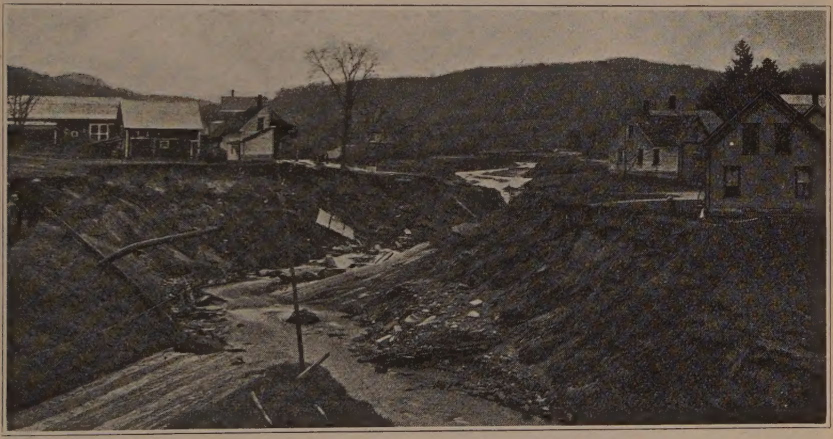


FIG. 1. — WASHOUT AT MACKVILLE, HARDWICK, VERMONT

I happened to live in the flooded area, at Montpelier, and was unable to get to the office for two or three days. There were only two or three other men living in Montpelier who were able to be at the office. After getting the family settled and taken care of, we set about to see what could be done in the way of repair and reconstruction work. We sent men out on different routes, 60 miles in each direction, and they came back and told what they had seen. Some could only get part way by car and had to walk long distances.

---

* Chief Engineer, State Highway Board, Montpelier, Vermont.

It was fall. There were a lot of bridges to be rebuilt and it was not very satisfactory weather for making surveys. We did not know, moreover, who was going to pay for the reconstruction, but we figured that probably all of it would have to be built during the next year and so we started surveying. We had three survey parties in the field at the time of the flood, and we picked up what new men we could get. Mr. Miller of the District Federal Office asked what we most needed, and we told him we wanted first survey parties. We got about fourteen survey parties in the field in about a week and started surveying the

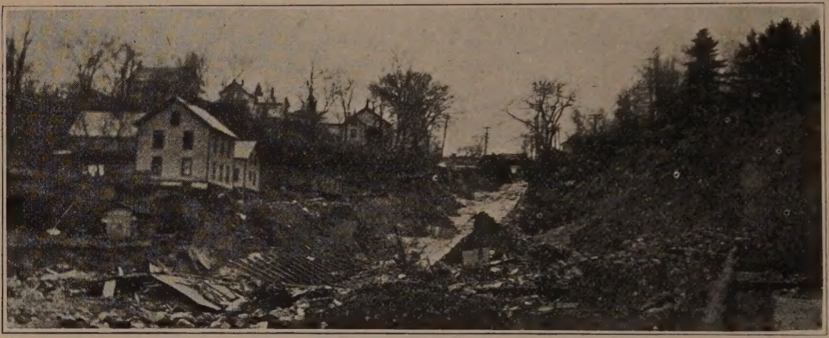


FIG. 2.—WASHOUT SHOWING DÉBRIS FROM WRECKED BUILDINGS

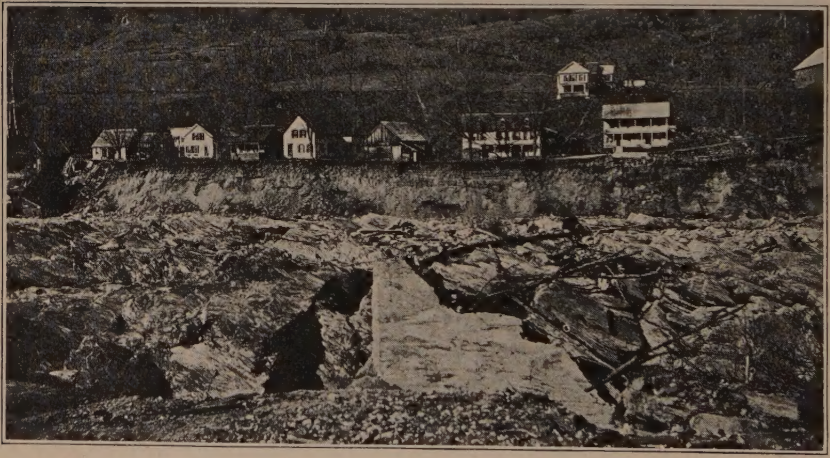


FIG. 3.—WASHOUT AT GAYSVILLE, VERMONT, TOWN OF STOCKBRIDGE

bridges. Shortly after that we started construction of some of the most necessary bridges, for which we were able to get plans right away; also, some temporary bridges were erected to get traffic going. In the meantime, all the towns affected by the flood were busy filling up holes, making detours and building temporary bridges. There were 1,214 bridges to be rebuilt. At one bridge in Waterbury we put in a pile trestle, and after about two more days of rain the water came up to ordinary spring high water and took out the trestle, which had to be rebuilt immediately.

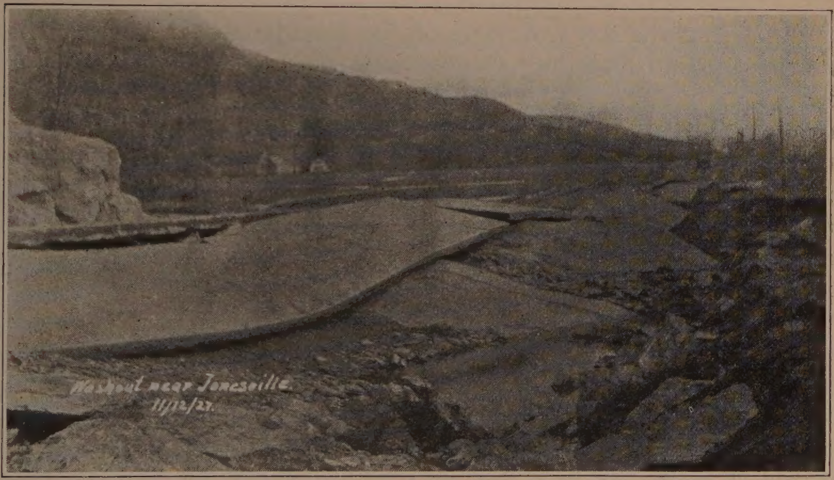


Fig. 4. — Washout near Jonesville, Vermont

In October of last year we had 45 engineers on our staff. This year we have 122. We have 185 of the larger bridges under construction by contract, and about 909 altogether going up and completed. The smaller bridges have been built by the forces that ordinarily build the State aid bridges.

A. J. Runnals.* — The mileage of road construction in Vermont has greatly increased during 1928 but the average costs of this work are but little different than for years before.

---

* Road Engineer, State Highway Board, Montpelier, Vermont.

AVERAGE COST PER MILE OF THREE TYPES OF ROADS IN VERMONT

TYPE OF ROAD	Previous to 1928	1928*
Gravel	$25,046 per mile	$27,289 per mile
Bituminous macadam	33,841 per mile	37,043 per mile
Concrete	42,476 per mile	49,030 per mile

* Costs for 1928 roads do not include flood projects.

Analyzing the costs of some of the subdivisions of the road construction we find that the pavement surface alone averaged up to this year $27,856 per mile, as against $31,145 per mile this year. Bituminous macadam (base and surface courses) averaged $15,389 per mile, which is practically the same as they are costing this year. Gravel surface (base and surface courses) averaged $7,131 per mile, which is also practically the same for this year's cost. This comparison shows that macadam surface averages twice the cost of gravel, and concrete twice the cost for macadam.

Average foundation costs for the various types of roads show that bituminous macadam foundation was considerably more expensive than for the other types, due to the design for this type of road. Our average cost for this item has been $5,923 per mile, as against $2,008 for gravel roads and $1,415 for concrete roads. We are, however, spending an average of $2,487 per mile this year for foundation for concrete roads. This increase in cost is due principally to the construction of the roads in sections of the State demanding additional sub-base.

Construction engineering costs on our road and bridge work combined average approximately $1,275 per mile, or approximately 4 per cent of the total cost of the work.

A study of Vermont road conditions shows that, utilizing existing road surfaces, the use of gravel as a base, of depth varying from a shaping course to 6 to 10 inches, is satisfactory for a concrete road as long as adequate side and surface drainage can be obtained. When the location is such that this cannot be accomplished through ordinary ditching and keeping the grade of the road up, it becomes necessary to increase foundations to as much as 18 inches of gravel to insure a proper base.

Our usual design of pavement is a 7-inch uniform slab with two 9-foot lanes, using double bar mat reinforcing of ⅜-inch bars, giving a total of approximately 42.33 pounds of steel per cubic yard, or 83.24

pounds per 100 square feet. This mat is supported on metal chairs giving a rigid mat easily fabricated off the road and hauled in trucks to the paver. Thickened edge type has been used in Vermont but never with as satisfactory results as the above type.

The principal causes of cracks in our pavements have been found to be from insufficient base over clay subsoil, and this is remedied by utilizing all the existing road material and raising the slab well above the natural ditch level, with an additional thickness of gravel sub-base. Unless 6 or 8 inches of gravel base is constructed under the slab over ledge subgrade we have found that we have been unable to prevent serious cracking of the slabs. In some localities we have increased this sub-base depth to 8 and 10 inches in order to provide proper drainage as well as cushion, and this remedy has done considerable toward reducing the number of cracks. Lack of proper lapping of the reinforcing bars (our former standard was 6 inches, which has during the past year been increased to 12 inches) has caused many cracks to develop. Culverts are another source of cracks. Under our older pavements, these sections were bridged by the slab. Now, through the use of an expansion joint over every culvert, this difficulty has been almost entirely eliminated, and the roads, with few exceptions, present a good riding surface, free from bumps or cracks over the culverts. Corner and dowel breaks are very rare with our traffic and slab design.

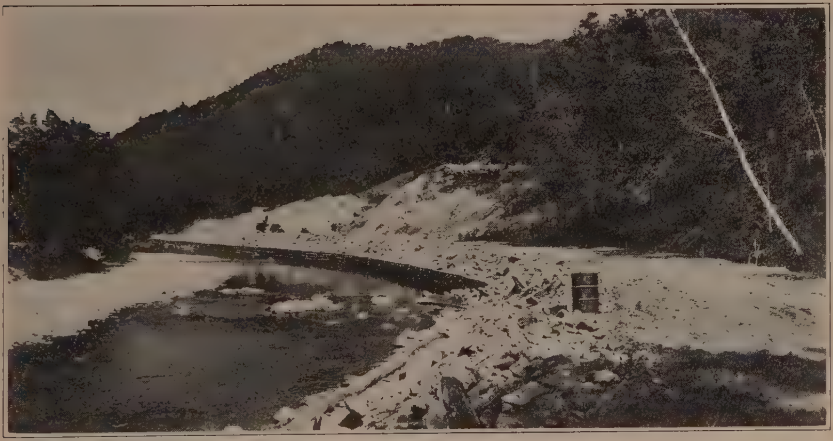


Fig. 5. — Along the White River in Towns of Bethel and Stockbridge, showing Timber Cribbing Construction

Macadam design best suited for average Vermont conditions demands 9, 12 or 18 inches of sub-base of field or quarry stone, this being built on a 3 or 4 inch sand or fine gravel cushion to prevent clay from readily working up into the stone and also to act as a leveling course for the stone sub-base.

For the base and surface courses we are specifying a uniform thickness of 2 or 3 inches for the base course and 3 inches for the surface course, applying 2¾ gallons of asphalt per square yard. The application of 2¾ gallons of asphalt has usually been our maximum amount, according to the specifications and we find that better results are obtained through using this amount.

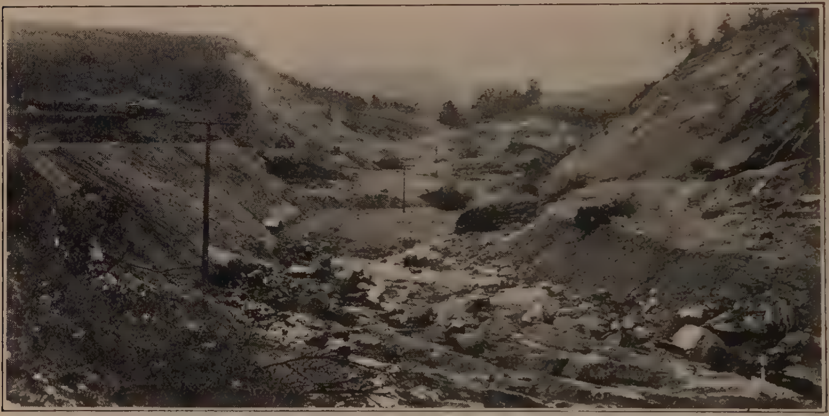


FIG. 6. — WASHOUT IN CAVENDISH VILLAGE

Washout is about 450 feet long, 500 feet wide and 160 feet deep
On left of picture is a new road being built

Gravel road construction, which is an important item on many of the roads in the State, varies from 21 to 24 feet roadway width and from a cross-section of 5–8–5 inches to 5–10–5 inches, depending entirely upon the location of the road, amount of traffic and the type of material available.

A. D. BISHOP.* — Previous to November, 1927, the Bridge Department of the Vermont State Highway Department consisted of a bridge engineer and about twelve draftsmen, most of whom were temporary men hired for the summer vacation, using our regular men who were on this class of work during the winter as inspectors during the summer, either on bridge work or on road work.

---

* Bridge Engineer, State Highway Board, Montpelier, Vermont.

The amount of work handled for the past four years had been approximately 100 State aid bridges per year, and an average of 8 to 10 Federal bridges per year. This permitted the direct supervision of all plans and considerable construction work which, in general, on State aid bridges was handled by force account.

Due to the great number of bridges lost in the flood of November, 1927, it was impossible to directly supervise the preparation of the plans, the survey work or the construction, and give the same the personal care which had been done on the previous work.

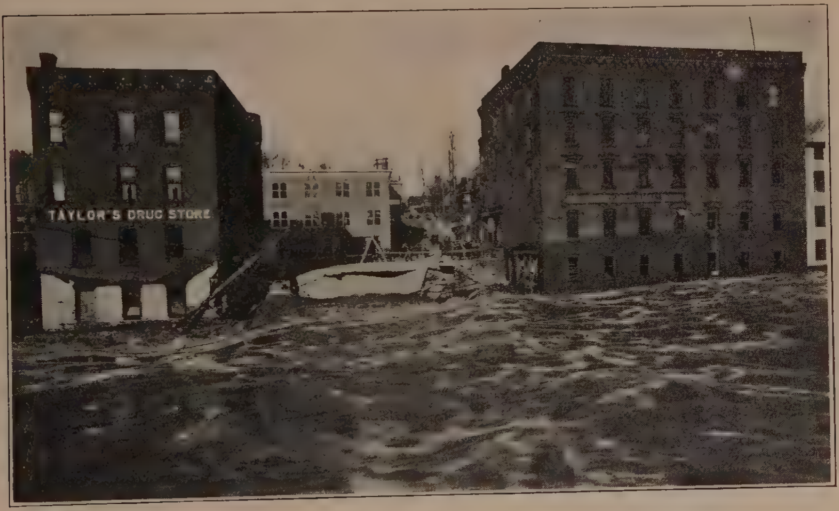


FIG. 7. — RIVER AT RICHFORD, VERMONT, DURING FLOOD

As soon as possible after the flood men were sent here from the Bureau of Public Roads to assist the State as the State saw fit. A bridge engineer from the Washington office and myself visited the sites of the principal bridges destroyed by the flood in the early winter, and noted our recommendations for the type, span, change of location, if any, foundation requirements such as could be obtained from visual inspection, and the amount the grade should be raised on the approaches over the existing road. These data were extremely valuable in that it was impracticable to visit the sites of most bridges during the period they were surveyed.

The surveying of these bridges was handled by fourteen parties placed in districts, these districts being divided to approximately even up the survey work.

As soon as conditions were visualized from the flood, we increased our bridge organization to about thirty-five men, consisting of three steel designers, four concrete designers and about twenty-six draftsmen, including detailers, tracers and checkers, one man acting as layout man, that is, laying out the work to the squads, which were composed of about six men per squad, and one laying grades to meet the grade line of the bridge on its approaches. This organization functioned very nicely during the time necessary to get out the bulk of the plans.

We were able to maintain the organization in this way for about five months, when it became necessary to take care of inspection work in the field, and this organization has gradually grown smaller, so that at the present time there is one assistant and eight draftsmen with one designer, who takes care of checking the shop details for steel bridges.

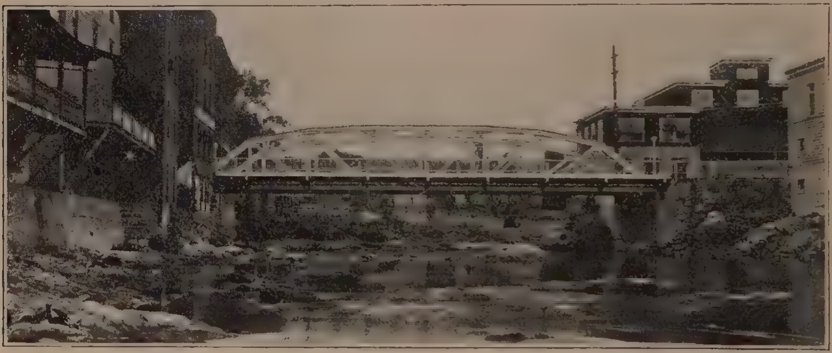


FIG. 8. — RIVER AT RICHFORD, VERMONT, UNDER NORMAL CONDITIONS

Of the work contracted this year, composed of 185 bridges, about 75 have steel superstructures, and we thought it advisable to have shop inspection, which is required by the Federal Government, on all bridges on which they give aid, and we have arranged to have one firm take care of the greater portion of our shop inspection.

It was readily seen that it would be impossible to take care of the office work in preparation of designs and plans as previously had been done; that is, previous to this time I, personally, had made practically all designs for steel bridges. This would be impossible with the number of designs necessary to make and to supervise the rest of the work.

For this reason we were loaned a first-class designer from the American Bridge Company to take care of steel designing, and were also loaned two men from the Bureau of Public Roads to take care of the same class of work. With our regular force of men who had had several years' experience in the department we organized our office in squads, hiring and borrowing additional men from private organizations, to draw up the designs and details from the sketch sheets, to design the concrete foundations and other work. It was also realized that it would be impossible during the winter, so as to have them available in the early spring, to draw up plans covering all the bridges necessary to be constructed this year. For this reason it was decided to standardize all the work possible.

It seemed impossible to attempt to standardize bridge abutments and bridge piers for steel bridges, due to the varying loads caused by differences in spans in combination with varying heights, and we have, in practically every case, designed and drawn up new abutment plans to fit the longer bridges.

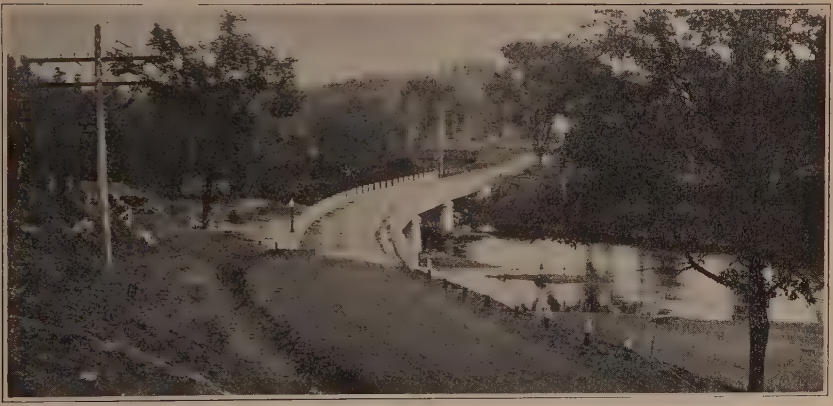


FIG. 9. — FULSOM CROSSING AT LYNDON, VERMONT

Standard slab spans (with both a solid rail and open rail) were drawn up, varying by 1 foot intervals for spans from 4 feet to 20 feet. Plans were also drawn covering T-beam spans (both open and solid rail), varying by 5-foot intervals from 25 to 55 feet, 55 feet being about the limit of span which is economical for T-beam design and also being the limit for the length at which reinforcing steel can be obtained without splicing.

A set of standards was also drawn for I-beam bridges, varying by 5-foot intervals from 25 to 70 feet to accommodate a concrete floor (with open or solid rail). These were to be used at the option of the department in contracting, and at the option of the men in charge of force account work where the work was done in that way. The cost of T-beams and I-beams for respective spans is practically the same. These standards also were made to accommodate varying widths of roadway and also made to fit a sidewalk where desired.

Standard culverts in all combinations between 4×4 and 10×10, for fills up to 3 feet; up to 10 feet and over 10 feet, caring for both square and skew conditions, were also standardized.

To care for bridges not requiring a concrete floor or light bridges, a set of standards was drawn up with two I-beams for a 12 or 14 foot roadway with timber framing and a 2×4 floor to accommodate 10-ton loadings. Also similar, with the exception of adding one beam, making a total of three beams, for a 16 or 18 foot roadway, these bridges to have wooden rails. To take care of the foundations for these bridges, gravity abutments were designed to care for slab spans from 4 to 16 feet in height, varying by 2-foot intervals, from the top of the footings to the bridge seats. These standards were enlarged to cover square bridges, 15°, 30° and 45° skews. To care for the I-beam and T-beam bridges, standards were drawn up for gravity abutments from 4 to 16 feet in height, varying by 2-foot intervals, the height being as above. To care for heights greater than 16 feet, and to make the same economical, the difference in costs increasing very fast for gravity abutments over 12 feet clear height, a set of reinforced abutments was drawn, varying by 2-foot intervals from 10 to 20 feet. These abutments are what is known as the half and half type, that is, half gravity and half reinforced, the reinforcements being placed in the back of the abutments to care for the tension. Twenty feet appeared to be the maximum height to which either type is economical, although it was necessary to draw up some designs with the abutments being 24 feet or a trifle over, clear height. These abutment standards were drawn for square and 15°, 30° and 45° skews. The same were designed and shown with or without piles. Also, standard piers for the same range of heights and under the same conditions were drawn to care for both slabs and T or I beams, square or skew spans.

A set of standard steel superstructures were designed for spans from 60 to 250 feet, varying by 10-foot intervals of span from 60 to 100 feet and 20-foot intervals above 100 feet for a standard width of 20-foot roadway. Also, standards were prepared for a 16-foot width of roadway, both of these standards being designed for H 15 loading, which is a traffic lane loading composed of 21,000 pounds concentrated load preceded and followed by a uniform load of 400 pounds per linear foot of traffic lane. In the design of the truss both lanes were considered loaded as necessary to produce maximum truss. The floor system was designed for the above loading or for two 15-ton trucks, 85 per cent on the rear, 13 feet center to center of axles, and 6 feet center to center of wheels, meeting or passing.

To care for narrow widths of 12 feet with a wooden floor and 16 feet widths with a wooden floor for H 10 loading a similar set of standards was prepared. All these were for square bridges, so when a survey was received from the field and had been plotted the spans were decided upon and standards used as far as possible. The standards have accommodated probably 75 per cent of the work done this year on small spans and superstructures for long spans. Where the heights of bridges exceeded a great deal over 20 feet from the footings to the bridge seats, approach spans have been added, placing the ends of the approach spans on skeleton abutments which are completely surrounded with fill, the face of the slopes being covered with riprap for protection against scour, this greatly reducing the cost of solid abutments and also furnishing additional waterway under flood water. As a rule where possible the elevation of the clearance line has been placed above the flood water as noted in the surveys.

H. K. Barrows.* — The flood of 1927 was, of course, very exceptional. The principal cause of the damage of all kinds was the tremendous volume of water and its sudden rise to heights that were entirely unknown up to that time. Thus in Waterbury, where a large loss of life occurred, the water rose 30 feet or more above the ordinary level, and reached portions of the town where no one conceived such a possibility. Owing to failure to grasp the situation, a great loss of life resulted; while at Montpelier, which is subject to overflow nearly every year, people apparently understood what was going on, and, as has been already stated, they stayed in their houses, and although the water level reached nearly to the second floors there was a surprisingly small loss of life, in fact, only one life was lost in that city in spite of the great area of overflow.

Another feature of the flood was the tremendous velocity of flow and the resultant scour. Much damage was occasioned in that way, particularly in certain locations, as Mackville, Gaysville, Cavendish, etc., where the water cut a new channel and went through portions of villages and overturned and carried away many houses.

---

* Construction Engineer, 6 Beacon Street, Boston, and Professor of Hydraulic Engineering, Massachusetts Institute of Technology.

The State authorities and the people of Vermont felt that at this time they should make an investigation to see what, if anything, could be done to prevent or lessen the effect of future floods, realizing that they are bound to recur.

As a matter of fact, in the last one hundred and sixty years for which records are available there have been in New England twelve great storms, of which three were general over all of New England. The three "major" great storms, so to speak, occurred in 1869, 1897 and 1927. In Vermont just about one hundred years ago, in 1830, there was also a flood the accounts of which read very much like those of 1927. Some 15 to 20 lives were lost, the same rivers were in flood, and great damage was done, although this was before the days of railroads. The resulting situation must have been very similar to that in 1927. Hence in one hundred years two such destructive floods have occurred in the State of Vermont.

It seems reasonable, then, to assume that the occurrence of such a flood is about once in fifty or seventy-five years, on the average. Of course no one can tell when such a flood may occur again. It may happen any time, even within a few years, or be postponed another one hundred years, as we hope will be the case.

For the purpose of flood investigation the Public Service Commission appointed the Advisory Committee of Engineers on Flood Control, numbering three engineers, to secure facts to present to the Legislature next January in regard to the whole matter. A thorough investigation has therefore been under way during the past summer, as a basis for that report.

It developed fairly early that the most helpful way of aiding the situation would be by the use of power storage reservoir systems, with flood relief more or less as a by-product. The efficiency of such a storage system was well illustrated by what happened on the Deerfield River in southern Vermont and western Massachusetts last fall. There are two large reservoirs on this river which control 182 square miles out of a total of about 500. As a result, no flood of consequence occurred on the Deerfield River. Without this storage the Deerfield River would have had its place in the newspaper headlines, as did some of the rivers in Vermont, for it naturally has steep slopes and a rapid run-off.

The use of detention reservoirs for flood control in a State like Vermont appears impracticable from the point of view of cost. Considering the total damage due to the flood in Vermont — approximately

$30,000,000 — it is obviously unwise to spend many millions of dollars in preventing such a loss, which will happen only once in fifty or seventy-five years. The investigation has therefore been directed chiefly toward working out a power storage scheme for each river which would incidentally take care of flood tendencies or reduce the flood hazard to such an amount that it may practically be disregarded.

As a basis for the investigation the United States Geological Survey topographic maps were used where available, which is for about two-thirds of the State. The other third of the State, which was not mapped, required some extensive survey work. Arrangement was made with the United States Geological Survey to make river strip surveys after we had looked over the ground and decided where it would be most useful to have them made. We have carried out that work and have mapped all the important portions of the rivers in the area of the State where topographic maps are not available — the upper Winooski, Passumpsic, Lamoille and White rivers.

Where topographic maps were available reservoir sites were selected and studied in the office in a preliminary way, and checked up in the field. Some forty surveys of dam sites at these reservoir sites were also made during the past summer, including the gathering of detailed information concerning the reservoir sites themselves.

While the results are not yet ready to give out, as the report of the committee has not yet been made, it may be stated that the number of reservoir sites that have been found on the various rivers is rather surprising, and apparently some good opportunities exist for storage reservoirs. Storage to be of value must be used in a power development. Hence a necessary part of the investigation has been to also plan out a scheme of power development for each one of these rivers.

It is hoped that the final results will lay a foundation for the proper development for both storage and power on all these rivers. While it will be many years before such schemes can be carried out, because the amount of power to be generated is large and beyond present market possibilities, it will, however, provide a comprehensive scheme which can be followed, and in the course of time substantial progress may be made toward these developments, incidentally reducing the flood hazard to a minimum.

A word about detention reservoirs. While it does not appear practicable to use them in the State of Vermont, there is one location in the State where such a natural basin exists, viz., on Otter Creek above Middlebury. It has been stated this evening that there was no great damage in that vicinity in 1927. Above Middlebury for a distance of about 25 miles there is a very large, nearly level area of low meadowland which overflows in ordinary high water in the spring. During the flood it overflowed to a greater extent than usual and acted as a detention basin, so that the water ran off rather gradually and with little damage along the stream below. It is an interesting example of natural channel storage reducing the flood discharge.

WILLIAM F. WILLIAMS.* — I think the speakers have given us a most interesting demonstration of the tremendously powerful destructive force of flood waters. Incidentally, they have shown that the Highway Department of the State of Vermont has certainly proven very efficient in its work of restoration.

While Massachusetts had a very heavy rainfall in November of 1927, and a large part of the water that did damage in Vermont had also to pass through Massachusetts, aside from one particular spot in the State no very serious damage occurred. Perhaps I should say two spots, because I do not want to take any credit for damage away from any town or city.

Immediately following the flood there were wild stories as to the tremendous damage done by the flood in Massachusetts. These gradually simmered down to figures that the ordinary human being could comprehend. This tendency to exaggerate seems quite common. I recall on one occasion last summer when there had been a rather heavy rainfall in the western part of the State, around New Marlborough and Sandisfield, where an estimate was made in the press that it amounted to something over $100,000. The actual cost of restoring the damage amounted to something over $3,000.

Quite a little general damage was done to the highways of Massachusetts during the November rains. The more serious cases of damage to State roads included a short section of the State highway near the Westfield River, which was washed out. A few sections of the reinforced concrete highway in Lee were undermined and had to be rebuilt, and there was a landslide on the Mohawk Trail above Charlemont. That was about all the damage done to the State highways. No State highway bridges were destroyed; but several town bridges went out. North Adams had a very peculiar experience. You may remember as you enter the city by the Mohawk Trail that you enter a street at the end of a dam over the Hoosac River, which was unable to take care of the flood flow and it went around the end of the dam and down the road. As this road has a very sharp grade at this point the water did a good deal of damage.

---

* Commissioner of Public Works, 413 State House, Boston, Mass.

At Williamstown the river undermined one of the abutments of the bridge on the main road into Vermont, but simply tilted it towards the stream so that we faced it with riprap and replaced the truss on the bridge seat.

The spectacular damage was confined to the little town of Becket. This was due to the giving way of a dam to an artificial pond near the village. Two streams come into Becket, one from the north and one from the ponds to the south. The dam gave way with the pond full, which released the water in a mass, and it came rushing down the valley and into the village in a solid wall of water. It took out several houses and mills, and washed away two highway bridges and also several railroad bridges. Strange to say only one life was lost with all that rush of water. The owner of the dam being more or less disturbed over its condition, as it was a very old structure, visited it, and seeing that it was about to fail warned the people in the village so that they all got out except one woman, who went back into her house to save something, was caught by the water and drowned.

Five or six years previously the State had built several reinforced concrete bridges over this stream, which meandered around through the village, but later our plans were such that we could not go on with the reconstruction of the road, and so the old road was still in use when the flood occurred. However, not one of the new concrete bridges was taken out. The wing on one was cracked a little and the railing at one end was cracked.

Sometimes I think if one of the bridges had given way it might have helped to save the road. As it was, the water went around the ends of the bridges into the road and took possession of it. The road has now been restored and the State and county have also rebuilt the village road and the two bridges that were destroyed. The Red Cross has practically restored the property damage. Two mills that were totally destroyed have not been rebuilt.

It is really remarkable what a tremendous force a large body of water has. After the flood I stood on the bank of the stream and tried to picture the location of two houses and a mill; but it was almost impossible, because you could not see anywhere any vestige or remnant of those buildings. There was not anything except a mass of boulders and scoured ledge and débris. Where they went to it is pretty hard to tell.

On the Connecticut River they had, of course, their usual high water, perhaps a little higher than in the past, although I do not think it reached the extreme high stage of many years ago. It was very largely backwater. It flooded cellars and filled the first floors of buildings, but I doubt if there was any particular damage different from that of the usual freshet.

The Westfield River has very steep slopes and rapid run-off, and at the "Frog Hole" bridge on the road from Springfield to Westfield the road and bridge were under water, and two people lost their lives attempting to follow the road in an automobile. Why they tried it is of course impossible to say. It was a foolhardy thing to do.

The State and counties have practically restored all the damage done by the flood to the town roads and bridges.

I was interested in Professor Barrows' remarks on storage basins, because that, in my opinion, is the fundamental background of control of these flood conditions. Of course, how much can be spent to anticipate events that take place only once in fifty or seventy-five years is an economic question, yet there are wonderful possibilites in storage reservoirs. Deerfield River is now a thoroughly conserved stream, owing to the protection afforded by two very large reservoirs built in Vermont. The Deerfield River caused no damage whatever in this flood, and yet in the past it has been noted for kicking up a great deal of trouble on the slightest provocation.

DESIGN AND CONSTRUCTION OF THE ATLANTIC CITY CONVENTION HALL

By Samuel L. Ware *

(Presented before the Designers Section, Boston Society of Civil Engineers, November 14, 1928)

In order to maintain her prestige as one of the foremost convention cities of the country, Atlantic City is building the largest auditorium in the world. This municipal project will have cost when finished about ten million dollars and will accommodate forty thousand people. The building occupies a block fronting on the Board Walk. It is located midway between the two principle groups of the largest and newest hotels. The building is 350 feet wide and has an average depth of 662½ feet, occupying the entire block.

The main auditorium floor is 350 feet wide and 450 feet long. It has balconies on three sides and a stage on the fourth. These balconies project 38 feet into the auditorium, and are so planned that there will be 15 feet clear height underneath them, thereby affording ample space for exhibition over the entire auditorium floor.

In addition to the main auditorium there is a large hall, 130 by 185 feet, on the second floor in the head house of the building, which can be used for smaller conventions, art exhibitions, banquets and dancing. It has a seating capacity of five thousand people, and includes a stage, a large balcony and a small musicians' balcony. There are committee and retiring rooms at each end of this hall.

On the Board Walk side of this hall are full height bronze doors and windows opening out on to a loggia 12 feet in width overlooking the ocean. The exterior side of the loggia consists of a series of arched openings with granite columns.

On the Board Walk level an arcade has been arranged across the front of the building. Along this arcade are located fourteen shops faced with marble and trimmed with ornamental bronze. In the center is a large ornamental entrance 50 feet in width, leading to the main auditorium. This entrance lobby has walls of limestone with a vaulted ceiling of

---

* With Cleverdon, Varney & Pike, Engineers, Boston. Formerly in charge of engineering in the architectural department, Lockwood, Greene & Co., Boston.

Gustavino tile. Corridors lead from it connecting with ramps leading to the lower and upper levels of the balcony of the auditorium.

There is a basement under the entire area. At the front of the building there are bathhouses with entrances under the Board Walk leading directly to the beach. Space has been provided on the ground floor to accommodate four hundred automobiles. One-way traffic is provided for by means of a ramp entrance on Georgia Avenue leading from the street down to the ground floor, with a similar exit opposite, on Mississippi Avenue. This will allow guests at conventions to arrive and depart without confusion of traffic. Platforms ramping up from the Board Walk grade extend the full length of the two sides of the building, and serve as exit areas to the auditorium.

The exterior walls of the head house are Indiana limestone backed up with 8 inches of solid brick and 4 inches of hollow brick supported on a steel frame. The remaining portion of the building is faced with a buff-colored brick. The exterior design is a modern adaptation of the Romanesque period, incorporating therein the spirit of Atlantic City.

The building is of first-class construction throughout, short span concrete slabs with steel frame. The basement floor is built at the level of the ground water, grade +2.0. The grade of the ocean adjacent to this site is zero for mean low water and +3.5 for mean high water. The maximum grade of the ocean recorded in the most severe storms has been +10.0. The construction of the basement and the boiler room, which is 15 feet below the basement, was designed for a full hydrostatic pressure, with water at +5.0.

The character of the soil is a fine sand extending to unknown depths. The foundation was built on twenty thousand piles 30 feet long with a minimum butt of 12 inches. The capacity of the piles was taken as fifteen tons. This capacity was not derived from any formula as it is impossible to drive piles in this soil to resistance. Fifteen tons per pile was established by previous load tests. There have been many buildings built in this vicinity on spread footings, but it was considered advisable in this case that piles be used, as the beach at this particular locality is building up from year to year and the level of the ground water is likely to change. In order to eliminate hazard of settlement by the lowering of the ground-water grade from any cause it was deemed wise to use piles. Piles were driven by water jetting to within two feet of their final position. A day or more was allowed for the sand to settle around the piles and then they were driven the last two feet by steam hammer. This eliminated the possibility of water or air pockets at the tips of the piles. In order to lower the ground water for the excavation of the basement and for pile driving work a wellpoint system of piping was installed over the entire site. The natural grade of the site was +10.0. Two thousand feet of main 6-inch pipe was laid on the four sides of the site, with twenty thousand feet of secondary lines of 3-inch pipe.

During the excavation of the boiler room, which was twenty-five feet below the street, two levels and in some cases three of wellpointing was necessary in order to efficiently operate the pumps.

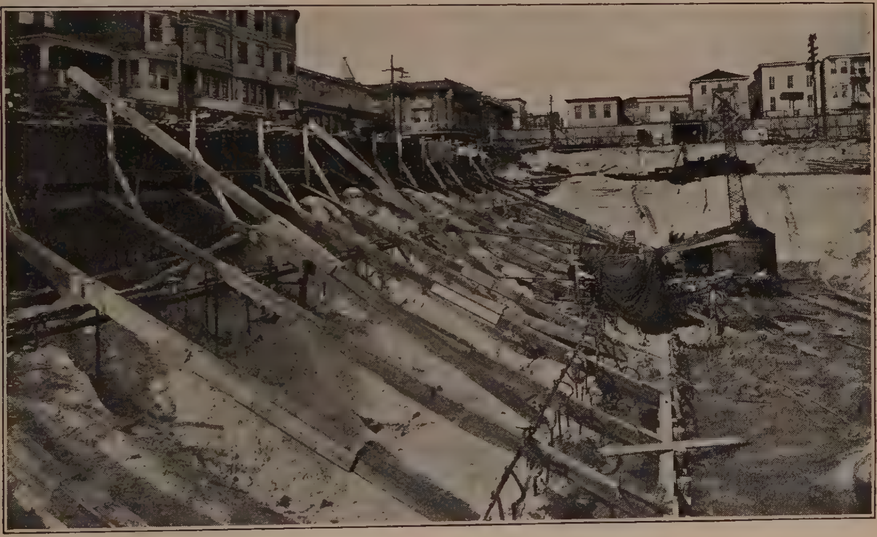


Fig. 1. — Boiler Room Excavation
Showing two levels of wellpoints

Piles were spaced 2 feet 6 inches on centers. No trouble was experienced in accurately spacing the piles and driving them straight by the water-jetting method in the type of soil encountered.

The basement or ground floor was designed for a 125 pound live load and a hydrostatic pressure of 3 feet at the level of the floor. The construction consists of concrete beams and slabs. The beams were tied to the concrete mats of the pile foundations by hairpin dowels in order to help resist the hydrostatic pressure. Wood forms were used for the beams. The sand was properly graded between beams and acted as a form for the concrete slabs. Beams and slabs were poured in one operation. Hydrolithic waterproofing was applied over the entire basement. No expansion joints were used. Special care was employed at pouring joints to insure good bonding of concrete. The floor was heavily reinforced for temperature, and has shown no visible cracks to date.

The boiler room was one of the most difficult features of design and construction in the entire job. The boiler room floor grade is −15.5, with a calculated hydrostatic head of 20 feet 6 inches. The action of the fine sand saturated with water proved to be of such instability that the boiler room may have as well been built in the ocean, except for the use of the wellpoint system. When the water was lowered to a sufficient depth by the wellpoint system, the sand was easily handled and would stand without shoring to a height of from 15 to 20 feet. The boiler room was large and with few interior points of support available to resist the hydrostatic pressure. It was necessary to build a 7-foot slab to resist most of this pressure by its own dead weight. It was found by tests that the piles exerted an appreciable resistance to uplift. This resistance was not figured in the calculations and was considered only as a factor of safety. Here again no expansion joints are made and large percentages of temperature steel were used. Steel reinforcement for the basement, the walls and the boiler room amounts to 1,500 tons.

Concrete walls are used up to the level of the main auditorium floor, grade 18.0, and in the head house portion to Board Walk grade.

The superstructure consists of the first, second, third floors and roof of the head house, grades 18.0, 36.0, 48.0 and 62.0, respectively, the main auditorium floor, grade 18.0, with side balconies. All curtain side walls are supported by steel columns and spandrels, and the main roof of the auditorium is supported by ten pairs of three-hinged arches.

The floors of the head house have no special features except for a few trusses which support the main ramps and upper and lower levels of the end balcony of the main auditorium. These trusses were built up of C. B. sections (Carnegie beams), and it is probably one of the first instances of their use in trusses.

The cast-steel pedestals supporting the main auditorium roof trusses rest on 4 by 8 foot concrete piers which are 20 feet high, the top being 2 feet below the auditorium floor. The ties for the bottom pins of the auditorium trusses form a part of the first-floor framing. The truss ties were designed for a 270,000 pounds tension plus the bending stress from the dead and live loads of the floor. Particular study of the splices was made by the fabricator of the ties of the trusses because of their excessive length. They furnished sub-punched tie plates at the third points so that they could be adjusted in the field and drilled to fit. These ties in all cases run over the tops of one-story columns to avoid tension in rivet heads. They also furnished one-eighth inch filler plates for connection angles for adjustment in erection in other places.

The ties were designed for a low combined stress in order to obtain a low strain. It so happened in the process of construction that the floor steel was completely riveted and the concrete poured before the load of the truss was imposed on the ties. It was found that when the ties assumed the stress of the truss load movement was experienced at the roller end of the truss. One-quarter inch was found to be the maximum movement.

Leaving the construction of the auditorium for a moment your attention is called to the end walls of the auditorium. Care for the tremendous wind pressure of these end walls was a special problem to meet. On the front walls the vertical columns were supported at the bottom at the grade of the head-house roof, and the top at the bottom chord of the main auditorium trusses. The bottom reaction of the wall columns was transferred to the row of columns at each end of the ballroom of the head house by a flat truss in the plane of the head-house roof, and in turn transmitted by portal bracing to the foundation.

The wind pressure of the Pacific Avenue wall of the auditorium was taken care of in a similar manner. Cross-bracing instead of portal bracing was used in the row of columns each side of the stage to carry the wind loads down to the foundation. The main auditorium trusses were of a three-hinged type, 334 feet 3¼ inches pin to pin with a rise of 136 feet 4½ inches. They had a 7-inch diameter crown pin and an 8½-inch bottom pin. The chord members were of a tee section with an 18-inch stem plate, two 8 by 8 angles and one or more 18-inch flange plates. The compression web members at alternate panel points where purlins occurred consisted of four angles and two angles at intermediate panel points. Tension web members consisted of two angles.

The tee section type of chord worked out very satisfactorily. The use of large gussets was eliminated and secondary stresses were minimized. The general shape of the truss is a curve, and is made up of a series of straight members changing direction at alternate panel points where splices occur.

No abutting compression members were employed, the transmission of stress at all points being done entirely by rivets. One-inch rivets were used at the truss joints and ⅞-inch rivets for bracing connections. Here again particular care was taken by the fabricators in the manufacture of these trusses. All material of these trusses were sub-punched one-quarter inch smaller. One-half of each truss was laid on the assembly racks to ordinates of the curvature, bolted together and properly reamed to size. For ten pairs of trusses it is realized that this work involved the setting up and assembly of forty units.

Referring to the former mention of the end walls of the auditorium, the top support of the wall columns was provided with a sliding connection to the bottom chord of the end trusses. These sliding joints allowed horizontal and vertical movement between the tops of the columns, which were embedded in the brick wall, and the truss chords, which are free to move under varying temperatures. It is to be realized that the trusses, wind-bracing and cross-bracing between pairs of trusses are independent of all other steel framing and brick walls.

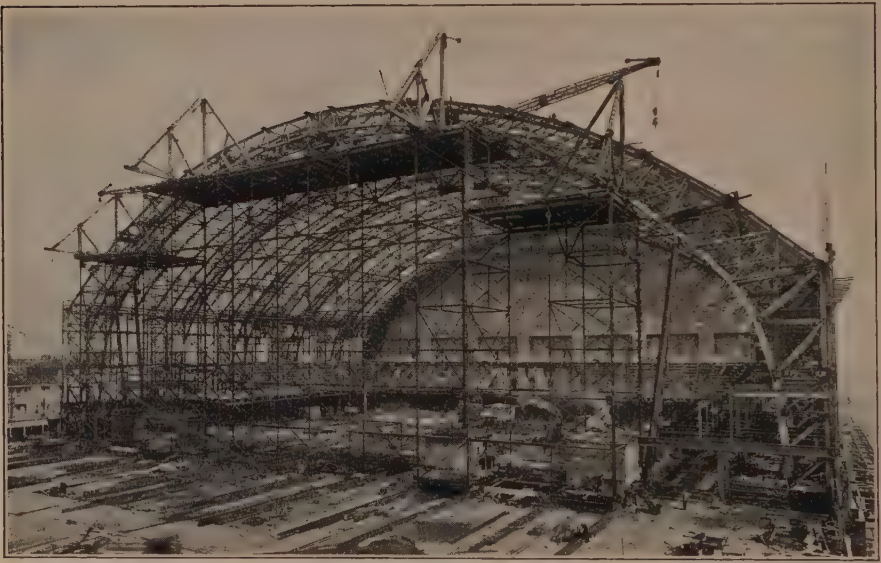


Fig. 2. — General View of Main Auditorium

Showing roof arches partially erected

At the intersection of the walls and the ceiling soffit of the trusses, joints of copper sheets were installed to allow for movement at these points. The trusses were designed in pairs 10 feet on centers and the pairs 49 feet 2 inches on centers. Purlin trusses 39 feet 2 inches long and 3 feet 6 inches deep are spaced 24 feet on centers, and come at every other panel point. Jack rafters, 15-inch I-beams, are framed to the purlins at the third points. Secondary 7-inch channels, 6 feet on centers, receive the 3-inch solid gypsum roof slab.

In order to provide lateral support for wind pressure at the upper ends of the columns in the end walls of the auditorium where the sliding joints occur two sets of cross-bracing in the plane of the upper chords of the trusses were employed in the first and fourth bays at each end of the roof. Each set is designed to take one-half the wind load of the upper portion of the end wall. It was afterwards deemed advisable to install for erection purposes additional cross-bracing in the second bay from each end of the roof, thus obtaining a system of bracing approximately 100 feet in depth for the first three pairs of trusses erected. Wire guys were used and maintained until these first three pairs of trusses were erected and riveted, and the cross-bracing 50 per cent riveted. This bracing consists of 6 by 4 angles flush with the plane of the roof and spliced with gussets at the intersection of the jack rafters and the truss chords. The interior bracing in the pairs of trusses consists of one 5 by 3½ by ⅜ angle for tension members and two 5 by 3½ by ⅜ angles for compression members. This cross-bracing occurred in the horizontal planes of top and bottom chords of the trusses and in vertical planes at every panel point.

Six towers were used for the erection of the trusses. Trusses were assembled in place in 24-foot lengths and bracing connected as the work progressed. They were completely riveted to within eight panel points of the crown pin, the remainder being half bolted and half pinned and all the bracing bolted before the erection towers were removed.

The only point of deflection necessary to observe was at the haunch of the truss, at which point we allowed a clearance between the auditorium wall and the trusses. The deflection of the trusses at the haunch point for the dead load was figured to be by the method of internal work of distortion two inches.

Careful tests were made during the erection of the trusses. Three measurements were taken, first with the weight of the trusses alone, second with the filling in framing of the roof, and third with the roof covering of 3-inch gypsum. These measurements averaged 1½, 1¾ and 2 inches, respectively, thus indicating that with the size and type of these trusses the theoretical deflection checked with the actual.

OF GENERAL INTEREST

FLOOD FLOWS IN NEW ENGLAND IN NOVEMBER, 1927

With Notes on the Operation of the Miami Conservancy Flood Control Works

*By J. H. Kimball**

The very interesting illustrated report on the recent floods in New England, given by Prof. H. K. Barrows before the Sanitary Section on January 4, 1928, has prompted the following notes, relating principally to the works of the Miami Conservancy District of Ohio.

When a flood of unusual intensity occurs, an opportunity is provided for the collection of data on the amount of flood water, for which provision should be made in our rivers and smaller streams. As a rule, the heavy flows occurring at any one point are but warnings of heavier flows to come in the future. Too often, whenever a river stage exceeds that recorded before, this stage is considered the maximum to be expected. Acting on this assumption cities have built levees to the height, or to a slightly greater height, reached, believing that they are thereby made safe against future disaster. The earlier history of Dayton, Ohio, affords an illustration of this method of designing protection against floods. Following a flood which occurred in 1847, a levee was built which was said to give complete protection for the future. In 1898 there was a serious flood which overtopped the levees built up to that time, and in the following year the levees were built to an additional height of about three feet. In 1913, the year of the great disaster, the flood flow amounted to about three times that of the flood of 1898. Great floods have occurred repeatedly, taking cities and towns completely by surprise, but an investigation of the facts has shown that these disasters were inevitable whenever the right combination of circumstances should occur.

A determination of the flow rates reached in the recent floods and a study of the conditions which produced them will be of great assistance to the engineer who must use a knowledge of actual past flows in his design of protection works. It would be inexcusable for him to proceed without adequate data and study, and to lead a community into a false feeling of security by construction based on such methods as were adopted in Dayton previous to 1913. It is not to be expected that an efficient plan for the protection of the Mississippi River valley can be worked out until a scientific and adequate study of the probable future flood flows has been made.

---

* Assistant engineer, with Metcalf & Eddy, Statler Building, Boston. Formerly assistant chief engineer of the Miami Conservancy District.

It is gratifying that the United States Geological Survey has authorized Mr. H. B. Kinnison to collect flood flow data on the flood of last November. A comparison of some of the flows determined by him with other available records is offered in Fig. 1. The data collected by Mr. Kinnison are very valuable contributions to our knowledge. The records used in the illustration beside those of the November flood are the maximum flood rates reported in the paper on "Flood Flow of New England Rivers,"* by Mr. C. H. Pierce; the maximum rates determined for the Miami River and its tributaries on March 25, 1913, the date of the Dayton flood; and flood rates in Pennsylvania and Maryland due to the storm of May 31–June 1, 1889, which caused the disastrous Johnstown flood. In the last mentioned there was a rainfall at some stations in western Pennsylvania exceeding 8 inches in 24 hours. The records available to Mr. Pierce and given in his paper were principally those over a comparatively short period, many of them being for periods of from ten to twenty-five years. The wide difference between those and the flood rates determined for the November flood illustrates the danger of using short-time records.

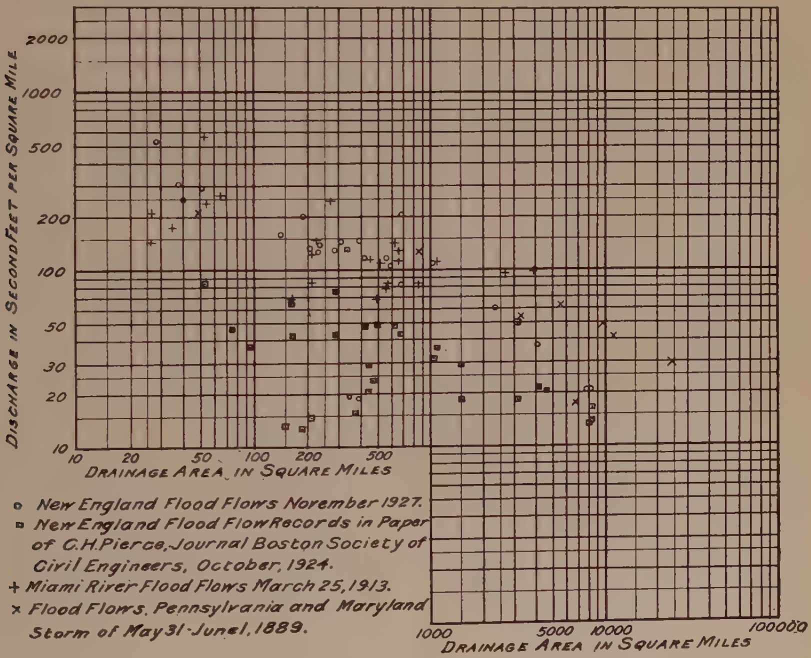


FIG. 1. — MAXIMUM RATES OF FLOOD FLOWS

No attempt is made to show a curve or deduce a formula indicating the maximum flood rates to be expected, as it is believed that a flood protection problem should be studied by a careful consideration of all available data and an investigation of the conditions influencing the flood run-off in the individual case, rather than to follow a formula which may not be applicable to the case in hand. It is interesting to note, however, that a line drawn along the higher rates in the figure would touch or run close to rates found in the flood of November, 1927, the Miami River flood and that in Pennsylvania and Maryland. These examples, taken from sections at a considerable distance apart, suggest that any portion of the United States located east of the Mississippi River and north of the Mason and Dixon line is subject to rainfall and run-off conditions capable of producing maximum flood damage.

---

* Journal of the Boston Society of Civil Engineers, October, 1924.

Probably the most complete study of flood rates in a major flood in this country was that made with reference to the Miami River in Ohio. An engineering force was placed at work for the city of Dayton within six weeks of the flood of 1913, and its first duty was the definite record of thousands of high-water elevations throughout the length of the river. Based on these, computations were made of the flood flows in the river and its tributaries. The results are worthy of careful study, and the conditions which influenced the run-off in the Miami valley should be carefully considered in comparison with conditions elsewhere.

Snow did not contribute to the flood in that river in 1913 and there were no failures of dams precipitating impounded water into the river. Although the surface of the drainage area is rolling, the slopes are not extreme and there are large areas of flat land. Notwithstanding the absence of features that have contributed to the great flows in other floods, there was an extreme rate of run-off in March, 1913. A computation of the total flow for the period during which the river rose and receded to the stage existing at Dayton at the beginning of the storm showed a run-off of 90 per cent of the rainfall on the drainage area above the city. It was also computed that the peak in the river flow reached about 95 per cent of the peak of the rainfall averaged over a period of thirty hours. This period has been observed as the approximate time required for the concentration of the flow at Dayton.

The reason for the remarkable rates of run-off was found in the condition of the ground. In the preceding January a heavy storm occurred over the Ohio River valley, causing serious flood stages along its course and causing large flows in the Miami River. Conditions at this season of the year are not conclusive to drying saturated ground. On March 20–23 there was a storm over the Miami River valley, and when the great storm of March 24–27 came, with only a sufficient interval between to mark a distinction between the storms, there was no available ground storage, and the falling rain was promptly discharged into the river system. The Mississippi River valley in the spring of 1927 was subjected to heavy rainfall for a considerable period previous to the flood, and similar conditions favorable to flood run-off were caused in New England by the wet season existing weeks before the flood came.

It is to be remembered that available records of river stages on any particular stream in this country are of too limited extent to reveal the magnitude of the greatest flood that can definitely be stated to be the maximum that may occur. There are comparatively few streams on which reliable records have been kept for more than twenty-five years. The highest Ohio River stage known to have been reached at Pittsburg occurred in March, 1763, which is one hundred and sixty-five years ago. This indicates the necessity of an adequate study of all data bearing on the individual case. The experience at Pittsburg, however, should not be taken as showing that extreme floods occur only at rare intervals. An extreme stage on the Ohio River at Cincinnati occurred in 1882. This was succeeded in the following year, 1883, by a larger flood, one in which the stage exceeded any previous record. The next year, 1884, a still greater stage was reached. Although there is no rule about the time that the next flood may be expected, data are available on which it is possible to estimate, with a fair degree of accuracy, the amount of flood flow for which provision should be made.

In reports that have been made upon the New England floods, attention has been called to the effect of certain reservoirs in controlling the flow in the river below. This has led some to believe that these reservoirs, built for power purposes, were acting in the same manner as those built by the Miami Conservancy District for flood protection. There is a sharp distinction between the reservoirs of the Conservancy District and those built for water supply, water power or irrigation, which should be kept in mind. The former are more properly called retarding basins. They are formed by dams through which the conduits are permanently open, no provision having been made for gates of any kind. The dams were built as high as conditions permitted, and the river channels through the cities below them were enlarged. When a heavy storm occurs, both the retarding basins and the river channels below come into play at once. Water accumulates in the basins only when the inflow to the basins exceeds the capacity of the conduits through the dam. The following table shows the run-off in inches of depth over the watershed that can be cared for by each of the five dams of the system:

MIAMI CONSERVANCY DISTRICT RETARDING BASINS

[Rate of run-off required to fill basins to spillway level within time stated]

BASIN	DURATION OF FLOW					
	0 Days	1 Day	2 Days	3 Days	4 Days	5 Days
Germantown . . .	7.3	8.6	9.8	11.0	12.2	13.4
Englewood . . .	8.8	9.4	10.1	10.8	11.4	12.0
Lockington . . .	6.6	7.8	8.9	10.1	11.2	12.3
Taylorsville . . .	4.4	6.1	7.8	9.4	11.1	12.8
Huffman	4.6	6.3	7.9	9.4	11.0	12.6

Taking the Taylorsville basin for an example, it will be seen that although this basin would contain, when full to spillway level, only 4.4 inches of run-off, it could regulate the run-off of 12.8 inches from a storm spread out over five days. During the period when the basin is filling, the outflow from this basin is increasing, reaching 53,600 second feet when the water surface reaches the crest of the spillway. This flow is equivalent to 47.3 second feet per square mile for the drainage area of 1,133 square miles. The river through the cities was enlarged to accommodate this flow together with that contributed by other branches of the river.

Another feature of these basins should

be emphasized. The Miami Conservancy District basins are empty within a short time after the flood flow occurs. The purpose of the water supply or water power reservoirs is to retain the flow for future use. This would mean the entire flow of some storms. Had reservoirs for power purposes been in existence on the Miami River watershed in 1913, they probably would have been filled by the heavy January storm and kept full by the rains falling between that storm and the one of March 24–27. In this case they would have been of slight value when the flood came. For a safe use of reservoirs for both power purposes and flood protection, the capacity required for flood protection should be added to that desired for power or water supply. There always exists the temptation when water is stored for water supply or water power to increase the storage. Recognizing the danger to the valley below that might result from the use of the Miami retarding basins for water-power reservoirs at some future time, the directors of the district placed at each dam a monument on which was inscribed the following warning:

> The Dams of the Miami Conservancy District are for flood protection purposes. Their use for power development or for storage would be a menace to the cities below.

This warning is seen to be of great value when it is remembered that one or two generations may pass with no storm requiring the retention of a volume of flood water approaching the basin capacity.

Some data on the cost of the New England flood have been published. The cost of such disasters, as commonly reported, fails to enumerate all of the expense suffered. In addition to the value of bridges, buildings, other structures and property carried away or damaged by the flood water, there is another and sometimes much larger loss in the depreciation of the market value of the property within the flooded area or within its influence. There is also the blow given to the community as a whole, the effect on its income from taxes and upon its attractiveness as a place of residence or a field for business operations A real estate dealer in one of our eastern cities which was visited by a flood expressed his judgment that certain new residences suffer a loss in selling value of 50 per cent, although the physical damage to the property was slight. Property in the central section of Dayton, which possessed a high market value just previous to the flood, was almost without selling value after the flood until adequate protection was assured. This aspect of flood damage should be taken into account, especially when the value of protection is being considered.

The experience of cities in some of our major disasters has shown in a very emphatic way the cost of ignorance and indifference. The experience of Dayton is a case in point. It was estimated that the loss suffered by Dayton and neighboring cities amounted to about $100,000,000, with a loss also of between five hundred and six hundred lives. The protection works built since the flood cost the city of Dayton about $25,000,000, which was required in addition to the amount lost in the flood. If the city had had the advantage of a comprehensive engineering study, and had built the works required before the flood came, the financial burden would have been but one-fourth the amount the city was ultimately required to pay.

HOOVER IS ELECTED

*By Edward Grossman**

Herbert Clark Hoover has been elected President of the United States, and on March fourth next he will enter into office. He will then be the first *professional engineer* to occupy the Presidency, unless we consider George Washington a professional engineer. For three years, the only time he was in private employ, President Washington was a surveyor.

Mr. Hoover has achieved eminence both in his profession of mining engineering and in the profession of serving mankind. Governor Smith's eminence was achieved in the field of politics. Mr. Hoover is a great engineering administrator; his opponent for office was a great political administrator. When the voters came to choose between the two, the engineer was chosen, even though Mr. Smith's is the more picturesque figure. The voters chose the engineer because he is an engineer, because of his work as an engineer and as an administrator. It was a case of comparative values, and politics had to take a back seat.

Scientists and technologists are usually fair. They will choose the right man for the right job with as few errors as is humanly possible. The late President Wilson was first of all a scientist; he was a political scientist of superlative rank. It so happened that President Wilson was of the Democratic Party. That, however, did not stop him from appointing Mr. Hoover, a Republican, to important positions, where his genius in engineering and administration counted heavily. There is some quality, shared in common by all scientists and technologists worthy of the name, which causes them to set the available men in their proper places, where they will do a maximum of good. This quality is an advantage in government.

Different sorts of people are set in office at different times in a nation's history. In the early stages of a nation's development, or in time of stress, when leaders must be chosen who can accomplish difficult tasks, it is the man who does, not the man who talks, that is chosen. For the first President the United States elected George Washington, who, of all the Revolutionary leaders, very likely talked the least. The young country of Czechoslovakia chose for its President Professor Masaryk, a philosopher; he chose for his Minister of Foreign Affairs Dr. Edouard Beneš, a political economist. Both are by profession scientists of international reputation.

For examples of leaders chosen in times of stress we have General Grant, chosen President during the difficult reconstruction period after the Civil War; General Pershing, appointed Commander of the American Expeditionary Force in the late World War; and General von Hindenburg, elected President of Germany on a wave of popular reaction from the communistic tendencies of the period following the establishment of the republic. None of the three is greatly noted as a talker, but all are men of action. In times of stress, then, the talker is kept only as being a useful propagandist, while the doer does the hard work. The tables are turned by politicians in time of peace. Then the doer drops out of sight.

Yet we find, however, that the "man on the street" does not lose sight of the doer, despite the politicians. Given the chance to choose between practical politics and practical service, he will choose the latter. The only difficulty is that he is not often given the chance.

Not only is he not given the chance — politicians do not want to give him the chance. It is very doubtful if Mr.

---

* With Benjamin Steinberg, 6 Beacon Street, Boston, Mass.

Hoover would have been put forward had Mr. Smith's strength not been as great as it was. The engineer was nominated because the party did not have a single politician who could stand up against Governor Smith. It is a great compliment to both.

We have reached a period in history when the people desire government for the good of all. The old attitude of "What difference does it make who's elected?" is fast disappearing. It makes a difference, and the people know it.

Of candidates there are quantities, but the quality is not always good. Quality usually manages to keep out of politics. Why do not the great business executives, the great engineers, or the great scientists run for office? The answer is simple: there is not money enough in it to tempt the business man, and the engineers and scientists are too busy at their own work to care what happens around them. To the engineer and the scientist government is the business of lawyers and politicians.

But it is not. Government is everybody's business. And the man best fitted for it will be pulled into it whether his preference is for calculations or for anything else. Heretofore man has sought the office; in time office will seek the man. It behooves him to be ready.

At present, however, the average engineer does not take the trouble to join in the activities about him. He is a poor business man (although improving); he is afraid of the legal gibberish in which ten words do the work of one; he is content to let well enough alone. There is one thing he cannot avoid, however, his duty.

The various functions in government must be cared for by the men best fitted for the work, both by training and state of mind, in order to promote the general happiness. There will be a demand and it is the engineer's duty to be prepared to satisfy it. Besides his professional work he must take an intelligent interest in current affairs. He must not have only the narrow horizon of professional interests before him. His professional interests are not necessarily the world's, but the world's interests are emphatically his. Burying his head in the sand will not release him from his duty of participation. He must face the facts. He is wanted. The demand is not at present fully articulate, but it is there. The engineer is wanted; it is his duty to be ready.

INSPECTION OF BOSTON GARDEN

A large group of members of the Boston Society of Civil Engineers inspected the new Boston Garden on the afternoon of Wednesday, November 21, 1928, through the courtesy of the Boston Madison Square Garden Corporation.

The party was conducted by Mr. W. E. Belcher, Supervising Engineer, Dwight P. Robinson & Co., Inc., and by Mr. Frank C. Shepherd, Consulting Engineer, Boston & Maine Railroad.

Those present were given an opportunity to see all the features of the new coliseum, which seats 17,500 persons.

MEMOIR

Sturgis Hooper Thorndike *

DIED FEBRUARY 16, 1928

STURGIS HOOPER THORNDIKE was born on June 11, 1868, at Beverly, Mass., the son of Samuel Lothrop and Anna Lamb (Wells) Thorndike. Of English ancestry, his earliest known paternal ancestor was William Thorndike, who died at Little Carlton, Lincolnshire, Eng., in 1539. His earliest paternal ancestor in America was John Thorndike, who came from Little Carlton to Ipswich, Mass., in 1633, but who returned to England, leaving in America his son Paul, who settled in Beverly, Mass. His earliest known maternal ancestor was Harold de Vallibur (*i.e.*, Welles), who lived in Cumberland County, Eng., early in the twelfth century; his descendant, Hugh Wells, came from Essex County, Eng., to Watertown, Mass., in 1630, later going to Hartford, Conn., and then to Hadley, Mass.

Sturgis Thorndike's boyhood was spent largely in Boston and in Cambridge, Mass. After preparation at a private school he entered Harvard College, where he received his Bachelor of Arts degree in 1890. Later, having decided to follow an engineering career, he entered the Massachusetts Institute of Technology, from which he was graduated with the degree of Bachelor of Science in Civil Engineering in 1895.

Entering the office of the city engineer of Boston in 1895, at the beginning of a period of notable activity in city bridge construction, he gained during the next eighteen years a broad experience in the municipal engineering service of that city, primarily in its bridge-building undertakings. In 1906 he was appointed to the position of assistant engineer in charge of bridge design. In 1911, on the consolidation of the Engineering, Street, and Water Departments into the Department of Public Works, he became the designing engineer of the Bridge and Ferry Division of this, the largest of Boston's municipal departments. In this position he was in charge of the design of bridges and of other municipal structures.

Among the more important Boston bridges with which Mr. Thorndike had engineering connection may be mentioned the Charlestown, Summer Street, Northern Avenue, Chelsea Street, Chelsea North, Meridian Street, Broadway and Atlantic Avenue (or Cove Street) bridges, all over tide-water and each having an important draw-span; the Cambridge bridge (now known as the Longfellow bridge), across the Charles River between Boston and Cambridge, the most notable of the bridges of Greater Boston; and many important bridges on land, spanning railroad locations.

During this period, under leave of absence from the city engineer during term time, Mr. Thorndike served as instructor at the Massachusetts Institute of Technology in the scholastic years of 1904–05 and 1905–06, teaching hydraulics, stereotomy, bridge design and surveying.

In October, 1913, he resigned from the position of designing engineer of the Bridge and Ferry Division of the city of Boston, to engage for a time in private engineering practice.

On July 1, 1914, Mr. Thorndike joined with Frederic H. Fay, former head of the Boston Bridge and Ferry Division of the city of Boston, and with Charles M. Spofford, the head of the Civil Engineering Department of the Massachusetts Institute of Technology, in forming the engineering firm of Fay, Spofford and Thorndike. In this organization he was an active partner until his death.

---

* Memoir prepared by Frederic H. Fay and Charles M. Spofford, members, Boston Society of Civil Engineers.

Among the more important engineering projects under the direction of the firm in which Mr. Thorndike participated may be mentioned the design and the engineering supervision of construction of the Boston Army Supply Base, one of the larger waterfront terminals built during the World War for the use of the United States War Department; the Hampden County Memorial bridge across the Connecticut River at Springfield, Mass., a monumental structure of reinforced concrete arches; and the water supply, sewage disposal, central heating plant, and other engineering features for the town of Mariemont, recently built in the suburbs of Cincinnati, Ohio. In all these projects and in many investigations and reports, both engineering and economic, Mr. Thorndike's contributions were valued by reason of his sound judgment and his highly analytical mind.

Thoroughness and painstaking analysis were characteristics of Mr. Thorndike's professional work, and, indeed, of whatever he undertook, whether within or without the field of engineering. Inheriting, perhaps, a "legal" mind from his father, who was a lawyer of distinction, he early gave particular attention to the legal form of engineering contracts, and although without special legal training, he became an authority in this important branch of engineering work. Always keenly interested in fair play and the advancement of ethical standards, he was a most active member of the Committee of the Northeastern Section of the American Society of Civil Engineers which formulated the Code of Practice, adopted in 1927 by that society.

He was long active in the work of the Northeastern Section of that Society, of which he was president at the time of his death.

For thirty-two years he had been a member of the Boston Society of Civil Engineers, serving on many of its committees and also as a director in 1919 and 1920. He was a member of the American Water Works Association, the New England Water Works Association and the American Society for Municipal Improvements. He frequently contributed papers to these professional societies. He was an active member of the Boston Building Congress, the aim of which is to promote improved conditions in the building industry in Boston and in New England.

Mr. Thorndike was a member of the Harvard Club of Boston, the Harvard Club of New York, and the Harvard Engineering Society. He was long a member of the St. Botolph and Engineers Clubs of Boston and of the Boston City Club, as well as of the Boston Chamber of Commerce.

The Protestant Episcopal Church and its affiliated interests, a vital part of his life, equally with his professional work, claimed much of his time, effort and energy. From his boyhood — for fifty-two years — when in town he occupied his place in the family pew at the historic Christ Church in Cambridge. For thirty-five years he was elected to the Vestry, and at one time was a warden of that parish, of which he was always a most loyal supporter. He was also connected with St. Anne's Church in Lincoln, Mass., near his country home, serving on the Vestry there and giving to that parish his fostering care and intense interest.

Shortly before the war he assisted in organizing the Conference for Church Work, an annual gathering of workers in the Episcopal Church throughout the country and from abroad. Starting in a small way, the organization has outgrown the accommodations of the Harvard Divinity School, where its summer conventions were held for a time, and, in recent years, has met in the early summer at Wellesley College. For many years Mr. Thorndike was the managing executive of the Conference; through his efforts it was incorporated; and one of the last things he did was to finish the preparation of a code of practice for the conduct of its business.

His interests extended to many enterprises for the betterment of humanity; he was a member of the Fellowship of Reconciliation and of the Church League of Industrial Democracy; he was a member of the New China Committee and the Japan Committee; he was long active in the support of missionary work in the Protestant Episcopal Church; and he was a liberal contributor not only to church activities, but also to many other good causes.

For many years Mr. Thorndike made his summer home at Stony Farm, in Weston (and Lincoln), Mass., and during the latter part of his life Weston was his legal residence. He was interested in the affairs of the town, but never held office until 1926, when he was elected a member of the Water Supply Investigating Committee. In 1927 he was elected a member of the Board of Water Commissioners.

One of his chief characteristics was his love of nature; he was never more happy than when he was at Stony Farm. He knew and loved every tree on the place, and every living creature was his companion and friend. Mt. Monadnock in southwestern New Hampshire frequently lured him to its slopes, and for many years he was a constant visitor at The Ark, at Jaffrey, at the base of this mountain. One of his pastimes, in which he was often joined by his partner, Mr. Fay, was the surveying and the mapping of the many trails on the slopes of this beautiful isolated mountain.

Mr. Thorndike remained a bachelor throughout his life. A loyal friend and delightful comrade, with qualities of sincerity, unselfishness and earnestness rarely found, Sturgis Thorndike in his sixty years' span of life exerted a helpful influence among all with whom he came in contact, an influence far greater than he himself ever realized.

PROCEEDINGS OF THE SOCIETY

MINUTES OF MEETINGS

Boston Society of Civil Engineers

November 21, 1928. — A regular meeting of the Boston Society of Civil Engineers was held today in Chipman Hall, Tremont Temple, and was called to order by the President, Charles B. Breed. Three hundred and twenty-five members and guests were present.

The Secretary reported that the Board of Government had elected the following to membership in the Society:

Grade of Member: Donald V. C. Birrell,* John P. Kenney, Joseph C. Nowell, Jr.,* Leon H. Reed, Wallace W. Sanderson,* Harvard G. Young.

Grade of Junior: Arthur E. Johnson.

The President stated the topic of the meeting to be "Engineering Geology as applied to Location of Tunnels and Dams," and he introduced the first speaker, Mr. Frank B. Fahlquist.

---

* Transfer from Grade of Junior.

Other speakers and subjects were as follows: N. LeRoy Hammond, "Diamond Drill Borings for the Swift River Dams;" Richard R. Bradbury, "The Scituate Tunnel of the Providence Water Supply;" Irving B. Crosby, "Electrical Exploration Methods for Location of Dams and Tunnels."

After the presentation of Mr. Crosby's paper Mr. Frank E. Winsor, chief engineer, Metropolitan District Water Supply Commission, Dr. Charles Terzaghi and Prof. F. K. Morris of the Massachusetts Institute of Technology discussed the subject. A general discussion then took place.

Meeting adjourned about 9.45 P.M.

J. B. BABCOCK, *Secretary*.

Designers Section

NOVEMBER 14, 1928. — The meeting, held in the Affiliation Rooms in Tremont Temple, was called to order by Chairman Wm. D. Henderson at 6.20 P.M. The minutes of the preceding meeting were read and accepted.

"The Design and Construction Features of the New Atlantic City Convention Hall" was the subject covered by the speaker, Mr. Samuel L. Ware, formerly of Lockwood, Greene & Co. Mr. Ware, who was in charge of the engineering design of the auditorium, the largest in the world, described in detail, with the aid of many slides, numerous problems of design and construction and their solutions.

Mr. R. E. Rice of the Waterproofing Company told of the waterproofing of the substructure of the Convention Hall.

Both speakers answered freely the many questions which were asked.

Following a rising vote of thanks to Mr. Ware and Mr. Rice the meeting adjourned at 8.30 P.M. Fifty-two members and guests were present.

N. P. RANDLETT, *Clerk*.

Highway Section

NOVEMBER 27, 1928. — A meeting of the Highway Section of the Boston Society of Civil Engineers was held on Tuesday, November 27, 1928, in the Affiliation Rooms. Preceding the meeting members and guests met for dinner in the Boston City Club, Grill Room.

The Chairman, LeRoy M. Hersum, called the meeting to order at 7.20 P.M.

The minutes of the previous meeting were read and approved.

The Chairman then introduced the speaker, Mr. Clarence D. Pollock, consulting engineer, New York City, who delivered an illustrated lecture on "Stone Block Pavements; Salvaging of Old Pavements; Portland Cement Grout *v.* Asphaltic Fillers."

A discussion followed, in which Messrs. Tobin, Hersum, Atwood, Larned and Coburn took part.

There were twenty-one present at the meeting.

After according a rising vote of thanks to Mr. Pollock the meeting adjourned at 9.30 P.M.

ERNEST MATHERS, *Clerk*.

Northeastern University Section

NOVEMBER 6, 1928. — A meeting of the Northeastern University Section of the Boston Society of Civil Engineers was held this evening in Room 26 of Huntington Building at 7 P.M., with K. D. Sylvester presiding.

The speaker of the evening was Mr. P. B. Covey of the Manchester Engineering and Welding Company. Mr. Covey spoke on "Electric Arc Welding of Structural Steel and Ornamental Iron." Mr. Covey spoke on the different types of electric welding and methods used in the shops and on the job. He also compared electric welding with riveting, and stated that he believed welding would take the place of riveting in city construction work as the noise would be almost entirely done away with. He also showed pictures of some of the products put out by his company.

After the talk many questions were asked.

The attendance at the meeting was very good, forty members being present.

Previous to the meeting the members had supper at the Café de Paris.

Meeting adjourned at 10 o'clock.

KENNETH D. SYLVESTER, *Clerk*.

APPLICATIONS FOR MEMBERSHIP

[December 20, 1928]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of fifteen (15) days from the date given.

For Admission

Billings, John Avery, Newtonville, Mass. (Age 25, b. Burlington, Vt.) Spent three years in engineering college of University of Michigan and one year in University of Vermont, graduating from the latter with degree of B.S. in civil engineering. Experience: one year assistant engineer with the Southern Porto Rico Sugar Company; resident engineer for two and one-half years on State highway and bridge work over the Florida Keys; for a short time with C. H. Tenney & Co.; and at present is in the employ of Fay, Spofford and Thorndike. Refers to *C. A. Farwell, R. W. Horne, C. M. Spofford, L. B. Turner.*

Lindblad, Karl F., Everett, Mass. (Age 22, b. Everett, Mass.) Educated in the Everett schools and now a student at Northeastern University. While in the University, during co-operative periods, has been employed by Whitman & Howard, and Aspinwall & Lincoln. Refers to *W. J. Alcott, H. B. Alvord, C. O. Baird, C. S. Ell, J. W. Ingalls.*

Lindquist, Wallace Oscar, Worcester, Mass. (Age 21, b. Worcester, Mass.) Educated in the public schools of Worcester and entered Northeastern University in the fall of 1926. During co-operative periods has been employed as a rodman under supervision of L. O. Marden; also as transitman. Refers to *W. J. Alcott, H. B. Alvord, C. O. Baird, J. W. Ingalls.*

For Transfer from Grade of Junior

Nelson, Carl Harold, Dorchester, Mass. (Age 26, b. Sweden.) Graduate of Northeastern University in 1925. During co-operative periods was a transitman with Hartley L. White, 1923–25; transitman with Boston & Albany, 1925; assistant engineer, Norwood Housing Association, 1925 to date. Refers to *H. B. Alvord, F. M. Gunby, J. W. Ingalls, W. E. Nightingale.*

MacWilliams, Harold F., Newburyport, Mass. (Age 27, b. Newburyport, Mass.) Educated in the public schools of Newburyport, Huntington Preparatory School, Boston, and Northeastern University. From 1920 to the present with the Massachusetts Department of Public Works as resident engineer. Refers to *J. B. Babcock, R. W. Coburn, L. M. Hersum, J. E. Lawrence, F. T. McAvoy.*

NEW MEMBERS

Members

H. Kenneth Fairbanks, 87 Green Street, Augusta, Me.

John P. Kenney, 5 Park Square, Boston, Mass.

Daniel M. Moore, 9 Warren Street, Taunton, Mass.

Frank E. Packard, Jr., 12 Howard Street, Greenwood, Mass.

Harvard G. Young, Ellsworth, Me.

Juniors

Arthur E. Johnson, 12 Winslow Street, Hyde Park, Mass.

Ernest L. Proud, 8 Bartlett Street, Beverly, Mass.

DEATH

Howard C. Thomas . Dec. 10, 1928

INDEX

VOLUME XV, 1928

ABBREVIATION: I. — Illustrated

Names of authors are printed in *italics*

PAGE

Adams, Henry Sewall. Memoir . . . Nov., 442
Alexander, P. Atomic Hydrogen Welding Process . . . Feb., 93
Allen, C. Frank. Discussion — Fast Freight Transportation . . . Nov., 434
Allen, C. Frank. Discussion — Land Takings . . . Oct., 381
Annual Meeting — President's Address . . . April, 161
Application of Laboratory Research to the Study of Hydraulic Problems. *Dr. George H. de Thierry* . . . I., Jan., 1
Applications of Projection and Multiple Welds. *W. T. Ober* . . . Feb., 84
Arc Welded Steel Construction, Examples of. *Gilbert D. Fish* . . . I., Feb., 59
Asphalt, What It Is. *Charles F. Knowlton* . . . May, 254
Atlantic City Convention Hall, the Design and Construction Features. *Samuel L. Ware* . . . I., Dec., 467
Atomic Hydrogen Welding Process. *P. Alexander* . . . Feb., 93

Babcock, C. W. Reclaiming a Cast-Iron Waterwheel Casing . . . I., Feb., 88
Babcock, J. B. Discussion of Fast Freight Transportation . . . Nov., 435
Barnes, Howard T. Ice Engineering . . . I., Sept., 319
Barnes, Thomas Howard. Memoir . . . Feb., 101
Barrows, H. K. Reconstruction of Vermont Highways . . . Dec., 461
Barrows, H. K. Power and Reservoir Developments, Land Takings for . . . Oct., 363
Barrows, H. K. Discussion of papers on Land Takings . . . Oct., 388
Bartlett's Ferry Dam, Siphons at. *T. B. Parker* . . . I., Feb., 98
Bates, Stoddard B. Reconstruction of Vermont Highways . . . Dec., 449
Bishop, A. D. Reconstruction of Vermont Highways . . . I., Dec., 456
Boston Garden, Inspection of . . . Dec., 480
Boston Harbor, Tides and Currents . . . June, 313
Boston Society of Civil Engineers — "A Society to be Proud of" — President's address. *Frank A. Marston* . . . April, 161
Branch, Ernest W. Discussion of papers on Land Takings . . . Oct., 384
Breed, C. B. Discussion of Fast Freight Transportation . . . Nov., 433
Breed, C. B. Discussion of papers on Land Takings . . . Oct., 380
Bryant, Henry F. Duties of the Engineer in Connection with Land Takings in State and Municipal Projects . . . Oct., 357
Bryant, Henry F. Discussion of papers on Land Takings . . . Oct., 381

PAGE
Cameron, Edward H. Efflorescence of Brick Walls . . . March, 152
Cameron, Edward H. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . . . March, 141
Cameron, Edward H. Engineering Features of a Modern Glass Bottle Plant . . . . I., June, 288
Carpenter, George Ansel. Memoir . . . . . . April, 170
Cavendish, Vt., Work of the Flood at. *Irving B. Crosby* . . I., Jan., 33
Cleverdon, H. S. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . . . March, 121
Concrete and Other Building Materials in Exposed Locations. *John J. Harty* . . . . I., March, 111
Concrete, Practical Application of Water-Cement Ratio Method of Proportioning and Controlling, as Applied to Highway Pavements. *Wallace F. Purrington* . . . . . . May, 209
Crosby, Irving B. Geology in the Making — Erosion of a Canyon in One Night — The Work of the Flood at Cavendish, Vt. . . I., Jan., 33
Crosby, Irving B. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . . . March, 143
Culverts, Pipe, for Highways. *Dean Peabody, Jr.* . . . . May, 255
Cummings, W. F. Discussion of Fast Freight Transportation . Nov. 433

De Thierry, Dr. George H. Application of Laboratory Research to the Study of Hydraulic Problems . . . . . I., Jan., 1

Efflorescence of Brick Walls. *Edward H. Cameron* . . . March, 152
Engineering Features of a Modern Glass Bottle Plant. *Edward H. Cameron* . . . . I., June, 288

Farmer, F. M. General Principles of the Various Welding Processes I., Feb., 51
Farmer, F. M. Discussion of Welding Papers . . . . . Feb., 81
Fast Freight Transportation. *Lawrence Richardson* . . . I., Nov., 401
Fish, Gilbert D. Examples of Arc Welded Steel Construction . I., Feb., 59
Flood Control, Vermont, to Study . . . . . . April, 169
Flood Flows in New England in November, 1927. *J. H. Kimball* . Dec., 474
Fowler, F. N. Discussion of papers on Land Takings . . . Oct., 388
Freeman, John R., Travelling Scholarship . . . . . Jan., 35
March, 155
April, 168
Freight Transportation, Fast. *Lawrence Richardson* . . . I., Nov., 401

Geology in the Making — Erosion of a Canyon in One Night — The Work of the Flood at Cavendish, Vt. *Irving B. Crosby* . . I., Jan., 33
Glass Bottle Plant, Engineering Features of a Modern . . . I., June, 288
Grossman, Edward. Hoover is Elected . . . . . . Dec., 479
Grossman, Edward. Why Specifications? . . . . . . March, 153
Grossman, Edward. Publicity for Engineers . . . . . . June, 314

PAGE

Hammatt, Edward Augustus White. Memoir . . . . . Jan., 36
Harty, Arthur J. Transmission Line Projects in Land Takings . I., Oct., 369
Harty, Arthur J. Discussion of papers on Land Takings . . Oct., 385
Harty, John J. Concrete and Other Building Materials in Exposed Locations . . . . I., March, 111
Haughey, John D. Discussion of papers on Land Takings . . Oct., 390
Highway Pavements, Practical Application of the Water-Cement Ratio Method of Proportioning and Controlling Concrete as Applied to. *Wallace F. Purrington* . . . . . May, 209
Highways, Reconstruction of Vermont — a Symposium . . . I., Dec., 449
Hoosac Tunnel Enlargement . . . . I., Sept., 349
Hoover is Elected. *Edward Grossman* . . . . . . Dec., 479
Hydraulic Problems, Application of Laboratory Research to. *Dr. George H. de Thierry* . . . . I., Jan., 1

Ice Engineering. *Howard T. Barnes* . . . . . . I., Sept., 319
Inspection of Boston Garden . . . . Dec., 480

James, E. W. Desirable and Reasonable Traffic Regulations for General Use . . . . May, 236

Kimball, Frank Clifton. Memoir . . . . . . Feb., 101
Kimball, J. H. Flood Flows in New England in November, 1927 . Dec., 474
Knowlton, Charles F. Resurfacing Worn and Defective Pavements . I., May, 245
Knowlton, Charles F. What Asphalt Is . . . . . . May, 254

Laboratory Research, Application of, to the Study of Hydraulic Problems. *Dr. George H. de Thierry* . . . . . . I., Jan., 1
Land Takings, Duties of the Engineer in Connection with. *Henry F. Bryant* . . . . Oct., 357
Larned, Edward S. Discussion of Water-Cement Ratio Method of Proportioning and Controlling Concrete as Applied to Highway Pavements . . . . May, 224
Legal Aspects of Land Takings. *Harvey E. Weir* . . . . Oct., 375

Macdonald, Donald L. The Inspection of Structural Steel . . Sept., 342
MacMillan, A. B. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . March, 133
Main, Charles R. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . March, 150
Marston, Frank A. "A Society to be Proud of" — Address of President . . . . April, 161
Marston, Frank A. Progress in Sewage Treatment Abroad . . I., June, 259
Morrissey, Martin A. Discussion of Water Cement-Ratio Method of Proportioning and Controlling Concrete as Applied to Highway Pavements . . . . May, 229

PAGE

New Hampshire Public Service Commission — June, 316
Nichols, J. R. Discussion of Fast Freight Transportation — Nov., 432

Ober, W. T. Applications of Projection and Multiple Welds — Feb., 84

Parker, T. B. The Siphons at the Bartlett's Ferry Dam — I., Feb., 98
Pavements, Resurfacing Worn and Defective. *Charles F. Knowlton* — I., May, 245
Peabody, Dean, Jr. Pipe Culverts for Highways — May, 255
Pipe Culverts for Highways. *Dean Peabody, Jr.* — May, 255
Power and Reservoir Developments. *H. K. Barrows* — Oct., 363
Practical Applications of Welding Discussed — Feb., 97
Proceedings of the Society:
    Jan., 37; Feb., 104; March, 156; April, 171; May, 256; June, 316; Sept., 353; Oct., 396; Nov., 446; Dec., 483.
Projection and Multiple Welds, Applications of. *W. T. Ober* — Feb., 84
Publicity for Engineers. *Edward Grossman* — June, 314
Purrington, Wallace F. The Practical Application of the Water-Cement Ratio Method of Proportioning and Controlling Concrete as Applied to Highway Pavements — May, 209

Reclaiming Cast-Iron Waterwheel Casing. *C. W. Babcock* — I., Feb., 88
Reconstruction of Vermont Highways — a Symposium — I., Dec., 449
Resurfacing Worn and Defective Pavements. *Charles F. Knowlton* — I., May, 245
Rich, B. A. Discussion of Concrete and Other Building Materials in Exposed Locations — March, 130
Richardson, Lawrence. Fast Freight Transportation — I., Nov., 401
Roberts College. *C. Hale Sutherland* — I., Oct., 392
Runnals, A. J. Reconstruction of Vermont Highways — I., Dec. 453

Sargent, Hubert E. Reconstruction of Vermont Highways — I., Dec., 451
Sewage Treatment Abroad. *Frank A. Marston* — I., June, 259
Shaw, Arthur L. Discussion of Concrete and Other Building Materials in Exposed Locations — I., March, 117
Siphons at the Bartlett's Ferry Dam. *T. B. Parker* — I., Feb., 98
Snow, Bayard F. Discussion of papers on Land Takings — Oct., 382
Soil Corrosion Studies — Nov., 441
Specifications, Why? *Edward Grossman* — March, 153
Steel, the Inspection of Structural. *Donald L. Macdonald* — Sept., 342
Steel Construction, Arc Welded. *Gilbert D. Fish* — I., Feb., 59
Structural Steel, Inspection of. *Donald L. Macdonald* — Sept., 342
Sutherland, C. Hale. An American Technical School in European Turkey — I., Oct., 392

Thompson, Col. Sanford E. Discussion of Concrete and Other Building Materials in Exposed Locations — March, 137
Thorndike, Sturgis H. Memoir — Dec., 481
Tides and Currents in Boston Harbor — June, 313

PAGE

Towne, L. J. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . March, 126
Traffic Regulations, Desirable and Reasonable, for General Use. *E. W. James* . . . . May, 236
Transmission Line Projects, Land Takings. *Arthur J. Harty* . . I., Oct., 369
Turkey, An American Technical School in. *C. Hale Sutherland* . I., Oct., 392

Vacation Suggestion . . . . June, 313
Varney, Edward A. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . . . March, 145
Vermont Highways, Reconstruction — a Symposium . . . I., Dec., 449
Vermont to Study Flood Control . . . . April, 169
Vogel, Andrew. Welding Trusses for Industrial Buildings . . I., Feb., 71
Vogel, Andrew. Discussion of Welding Papers . . . . Feb., 80
Voss, Walter C. Discussion of Concrete and Other Building Materials in Exposed Locations . . . . March, 148
Voss, Walter C. Discussion of Water-Cement Ratio of Proportioning and Controlling Concrete as Applied to Highway Pavements . May, 226

Waghorne, A. C. Discussion of Welding Papers . . . . Feb., 79
Walker, Frank B. Discussion of Welding Papers . . . . Feb., 79
Ware, Samuel L. The Design and Construction Features of the Atlantic City Convention Hall . . . . . . I., Dec., 467
Waterwheel Casing, Reclaiming. *C. W. Babcock* . . . . I., Feb., 88
Water-Cement Ratio, Method of Proportioning and Controlling Concrete as Applied to Highway Pavements. *Wallace F. Purrington* . . . . May, 209
Weir, H. E. Discussion of papers on Land Takings . . . Oct., 383
Weir, Harvey E. Legal Aspects of Land Takings . . . . Oct., 375
Welding, Practical Applications, Discussed . . . . . Feb., 97
Welding Processes, General Principles of the Various. *F. M. Farmer* I., Feb., 51
Welding Trusses for Industrial Buildings. *Andrew Vogel* . . I., Feb., 71
Welds, Applications of Projection and Multiple. *W. T. Ober* . . Feb., 84
Wheeler, Bertrand Thorp. Memoir . . . . . . Nov., 444
Williams, William F. Reconstruction of Vermont Highways . . Dec., 464
Winsor, Frank E. Discussion of papers on Land Takings . . Oct., 386

Vol. XV DECEMBER, 1928 No. 10

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

INDEX TO ADVERTISERS

	PAGE
Abbott-McKay Corporation, 21 Pearl St., Boston	ix
Aspinwall & Lincoln, 46 Cornhill, Boston	iii
Associated Architects Printing & Supply Co., 25 Pearl St., Boston	x
Barbour, Frank A., Tremont Building, Boston	iv
Barrows, H. K., 6 Beacon St., Boston	iii
Bay State Dredging and Contracting Co., 62 Condor St., East Boston	x
Beattie, Roy H., 209 Bedford St., Fall River	ix
Berry Drafting Service, 101 Tremont St., Boston	iv
Bishop, J. W., Co., 683 Atlantic Ave., Boston	iv
Blair, Isaac, & Co., Inc., 433 Harrison Ave., Boston	xii
Boston Insulated Wire & Cable Co., Dorchester	vi
Bruno & Petitti, Contractors, 18 Tremont St., Boston	iv
Buff & Buff Co., Jamaica Plain	ix
Coleman Bros., 245 State St., Boston	ix
Crandall Engineering Co., 102 Border St., East Boston	xi
Crosby, Irving B., 6 Beacon St., Boston	iii
Eastern Bridge and Structural Co., Worcester	viii
Fay, Spofford & Thorndike, 44 School St., Boston	iii
Fuller & McClintock, 170 Broadway, New York	iii
Gibson & Williams, Inc., 65 Long Wharf, Boston	ix
Gow Company Inc., 956 Park Square Building, Boston	vi
Granite Paving Block Mfrs.' Assoc., 31 State St., Boston	xiv
Holzer, U., Inc., 333 Washington St., Boston	vii
Jackson & Moreland, Park Square Building, Boston	iii
Main, Inc., Chas. T., 201 Devonshire St., Boston	ii
Makepeace, Inc., B. L., 387 Washington St., Boston	Back cover
Metcalf & Eddy, Statler Building, Boston	iii
Monks & Johnson, 99 Chauncy St., Boston	iv
New England Foundation Co., Inc., 38 Chauncy St., Boston	ix
Old Corner Book Store, 50 Bromfield St., Boston	ix
Palmer Co., Inc., John E., 1012 Old South Building, Boston	ix
Pennsylvania-Dixie Cement Corporation, 250 Stuart St., Boston	viii
Pittsburgh Testing Laboratory, 101 Tremont St., Boston	iv
Portland Stone Ware Co., 80 Federal St., Boston	v
Rideout, Chandler & Joyce, 178 High St., Boston	ix
Scully Co., 238 Main St., Cambridge	vii
Simpson Bros. Corpn., 77 Summer St., Boston	v
Smith, B. F., & Co., Merchants Bank Building, 79 Milk St., Boston	ix

PAGE
Standard Oil Co. of New York, 31 St. James Ave., Boston xii
Stone & Webster, Inc., 49 Federal St., Boston xiii
Stuart, T., & Son Co., Newton, Mass. xi
Thompson & Lichtner, The, Co., Inc., Statler Building, Boston . . . iii
Thorpe, Lewis D., 6 Beacon St., Boston iii
Tucker, Edward A., Co., 101 Milk St., Boston iv
Warren Foundry and Pipe Co., 201 Devonshire St., Boston vii
Weston & Sampson, 14 Beacon St., Boston iii
Whitman & Howard, 220 Devonshire St., Boston iii
Worcester, J. R., & Co., 79 Milk St., Boston iii
Wright & Potter Printing Co., 32 Derne St., Boston x

A BUSINESS CARD in this Journal shows your interest in the Society and your appreciation of the patronage of its members

PROFESSIONAL CARDS

CHAS. T. MAIN, INC.
ENGINEERS
201 DEVONSHIRE STREET
BOSTON, MASS.

Industrial Building
Textile Mills
Hydro-electric Plants
Steam Plants
Reports and Investigations

Valuations for
Accounting
Taxation
Insurance
Purchase and Sale

IRVING B. CROSBY

Consulting Geologist

Investigations of Dam and Reservoir Sites
Water Supplies and Foundations
Quarries, Sand and Gravel Deposits

Application of Electrical Prospecting Methods to Foundation Problems

6 BEACON ST. BOSTON, MASS.

ASPINWALL & LINCOLN

Civil Engineers

46 CORNHILL
BOSTON

FAY, SPOFFORD & THORNDIKE

Consulting Engineers

Investigations Reports Designs
Engineering Supervision Valuations

Port Developments Industrial Plants
Bridges Buildings Foundations
Water and Sewerage Systems

44 SCHOOL STREET, BOSTON

FULLER & McCLINTOCK

Engineers

NEW YORK, 170 Broadway

PHILADELPHIA, PA.
Pennsylvania Bldg.
15th and Chestnut Sts.

KANSAS CITY, MO.
Walsix Bldg.
600 Walnut St.

H. K. BARROWS

Consulting Hydraulic Engineer

Water Power, Water Supply, Sewerage, Drainage. Investigations, Reports, Valuations, Designs, Supervision of Construction

6 BEACON ST. BOSTON, MASS.

METCALF & EDDY

Engineers

Harrison P. Eddy
Charles W. Sherman
Almon L. Fales
Frank A. Marston

John P. Wentworth
Harrison P. Eddy, Jr.
Arthur L. Shaw
E. Sherman Chase

Water, Sewage, Drainage, Refuse and Industrial Wastes Problems
Laboratory

STATLER BUILDING BOSTON, MASS

SANFORD E. THOMPSON, Pres. WILLIAM O. LICHTNER, Treas.

THE THOMPSON & LICHTNER CO., INC.

Engineers

Management and Production Investigations
Design and Engineering Supervision
Testing of Structural Materials

Offices and Laboratory, STATLER BUILDING, BOSTON

LEWIS D. THORPE

Civil and Sanitary Engineer

Water Works, Sewerage and Sewage Disposal

Supervision of Construction and Operation

6 Beacon Street
BOSTON, MASS.

WESTON & SAMPSON

ROBERT SPURR WESTON G. A. SAMPSON

Laboratory for the Analysis of Water, Sewage, Filtering Materials, etc., Design, Inspection and Supervision of Water Purification and Sewage Disposal Plants.

14 BEACON STREET, BOSTON, MASS.

WHITMAN & HOWARD

Civil Engineers

(Established in 1869)

220 Devonshire Street Room 504
BOSTON

J. R. WORCESTER & CO.

Engineers

BUILDINGS BRIDGES FOUNDATIONS
STEEL AND REINFORCED CONCRETE
DESIGNS INVESTIGATIONS
EXPERT TESTIMONY
CEMENT AND SAND TESTING

79 MILK STREET BOSTON, MASS.

Dugald C. Jackson Edward L. Moreland

JACKSON & MORELAND

Consulting Engineers

PARK SQUARE BUILDING BOSTON, MASS.

PITTSBURGH TESTING LABORATORY
Inspecting Engineers and Chemists

D. L. MACDONALD
New England Representative

101 TREMONT STREET, BOSTON

MONKS & JOHNSON
ARCHITECTS—ENGINEERS

99 Chauncy Street
Boston

FRANK A. BARBOUR
Consulting Engineer

Water Supply, Water Purification
Sewerage and Sewage Disposal

Tremont Building, Boston, Mass.

EDWARD A. TUCKER COMPANY
Contracting Engineers

CONCRETE REINFORCEMENT
REMOVABLE METAL FORMS
101 Milk Street, Boston, Mass.

BDS

BERRY
Drafting Service

101 TREMONT ST., BOSTON
LIBerty 2781

Your Professional Card
Would Look Well
IN THIS SPACE!

JOSEPH BRUNO **FRANK PETITTI** **ALPHONSO BRUNO**

BRUNO & PETITTI
CONTRACTORS

WATERWORKS, SEWERS, HIGHWAYS AND
CONCRETE CONSTRUCTION

18 Tremont Street, - Boston, Mass.

NEW YORK
101 Park Avenue

BOSTON
683 Atlantic Avenue

J. W. BISHOP COMPANY
GENERAL CONTRACTORS

PROVIDENCE
417 Butler Exchange

WORCESTER
109 Foster Street

SIMPSON BROS. CORPORATION

TRADEMARK REG.
LAID BY
SIMPSON BROS.
CORPORATION
77 SUMMER STREET
BOSTON.

ENGINEERS AND CONTRACTORS
FOR
REINFORCED CONCRETE
CONSTRUCTION

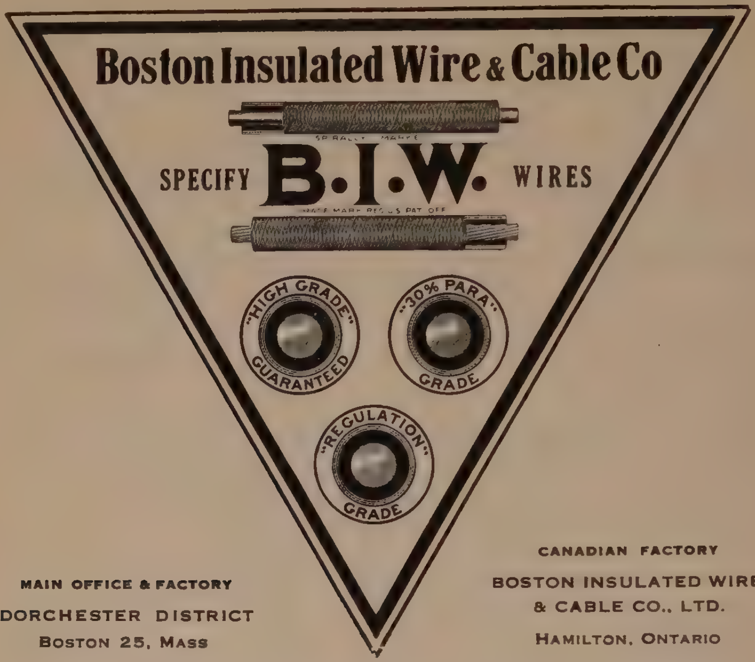
HASSAM CONCRETE STREET PAVEMENT

PORTLAND STONE WARE CO.
MANUFACTURERS OF
SALT GLAZED SEWER PIPE, FLUE LINING,
LAND TILE, OIL FIRE BRICK,
BUILDING MATERIAL
PORTLAND CEMENT

80 FEDERAL STREET
BOSTON, MASS.

FACTORIES
PORTLAND, ME.
PATTON, PA.

YARD
CHARLESTOWN
MASS.



Boston Insulated Wire & Cable Co

SPECIFY **B.I.W.** WIRES

TRADE MARK REG U S PAT OFF

MAIN OFFICE & FACTORY
DORCHESTER DISTRICT
BOSTON 25, MASS

CANADIAN FACTORY
BOSTON INSULATED WIRE
& CABLE CO., LTD.
HAMILTON, ONTARIO

FOUNDATIONS
ENGINEERS AND CONTRACTORS

The Gow Company Inc.
956 Park Sq. Building
Boston

GOW CAISSONS

RAYMOND CONCRETE PILES

SOIL TEST BORINGS

90 WEST ST., NEW YORK CITY
111 W. MONROE ST., CHICAGO

THE SCULLY COMPANY

Building Construction

238 MAIN STREET CAMBRIDGE, MASS.

WARREN FOUNDRY and PIPE CO.

(FORMERLY WARREN FOUNDRY AND MACHINE COMPANY)

MANUFACTURERS OF

Cast Iron Gas and Water Pipe

FLANGE PIPE SPECIAL CASTINGS

**201 Devonshire St.,
BOSTON, MASS.**
SALES OFFICES
**11 Broadway,
NEW YORK**

U. HOLZER, Inc.

BOOK-BINDER

333 WASHINGTON ST., OPPOSITE MILK ST., OR 24 PROVINCE ST.

ESTABLISHED 1870

All kinds of Books bound and repaired.
Maps and Charts mounted.
Portfolios, Scrap Books, Blank Books, etc., made to order.
Lettering in Gold; Paper-Splitting; Inlaying; etc.
Photographs Mounted on Card or Paper without Cockling.

**Main Shop
at
Hyde Park**

EASTERN BRIDGE

— AND —

STRUCTURAL CO.

Worcester, Massachusetts,
For Prices on all Classes of

STEEL AND IRON WORK.

WE DESIGN AND MANUFACTURE

ROOF TRUSSES, GIRDERS, COLUMNS, STAIRS
AND FIRE ESCAPES FOR BUILDINGS . . . .

FOOT BRIDGES, HIGHWAY BRIDGES, RAILROAD BRIDGES

We Carry a Large Stock of
I-BEAMS, PLATES AND ANGLES

Can Make Quick Deliveries. Send in Your Inquiries.

PORTLAND CEMENT

Pennsylvania *Clinchfield*
Dexter *Royal* *Penn-Allen*

PENNSYLVANIA - DIXIE CEMENT CORPORATION
BOSTON OFFICE, 250 STUART STREET

OFFICES
General Offices, NAZARETH, PA.
ATLANTA BOSTON BUFFALO CINCINNATI
JACKSONVILLE NEW YORK PHILADELPHIA

BUFF
TRADE MARK TRADE MARK

Transits and Levels

WORLD FAMOUS
FOR 66 YEARS

Buff precision and design is continuously in the forefront.

Send for New 1928 Catalog.

A picture in 6 colors sent gratis to engineers.

All Makes Repaired
at Low Cost

Buff & Buff Co.

Jamaica Plain,
Mass.

ABBOTT-McKAY CORPORATION
21 PEARL ST., BOSTON, MASS.
BRANCH: STATLER BUILDING

Drawing Material
Surveying Instruments
and Repairing
Blue and Black Printing

USED TRANSITS AND LEVELS FOR SALE AND RENT

RIDEOUT, CHANDLER & JOYCE

Engineers and Piping Contractors

178 HIGH STREET - BOSTON, MASS.

Steam Specialties, Engineers' Supplies
Piping of All Kinds Furnished or Erected

ROY H. BEATTIE

Harbor Improvements
Divers :: Lighters

209 BEDFORD STREET
FALL RIVER, MASS.

SCIENTIFIC BOOKS
AND PERIODICALS

THE OLD CORNER BOOK STORE
50 Bromfield Street
BOSTON, MASS.

JAMES R. GIBSON ALEX. K. WILLIAMS

GIBSON & WILLIAMS, INC.

BUILDING CONTRACTORS

MEMBERS
MASTER BUILDERS' ASSOCIATION,
BOSTON, MASS.

OFFICE: 65 LONG WHARF, BOSTON

JOHN E. PALMER CO., INC.
JOHN E. PALMER
DANIEL S. BELL JOHN A. STARR

CONTRACTING ENGINEERS
Contractors for Sewers, Water Works,
Concrete Construction, Foundations,
Roads, Landscape Work, Etc.

1012 OLD SOUTH BUILDING
294 WASHINGTON ST., BOSTON, MASS.

B. F. SMITH & CO., INC.
ESTABLISHED 1878

Engineers and Contractors
ARTESIAN AND DRIVEN WELLS
FOUNDATION BORINGS

79 MILK STREET
BOSTON, MASS.

New England Foundation Co., Inc.
Engineering and Construction

Simplex Concrete Piles

Caissons — Difficult Foundations

38 CHAUNCY STREET BOSTON, MASS.

COLEMAN BROS., Inc.
JOHN F. COLEMAN, Pres. and Treas.
General Contractors and Builders
Main Office
245 STATE STREET, BOSTON
Brewer Building CONGRESS 6886

Tracing Cloth Reproductions by Our Gelitho Process

We are its sole owners and producers.

BLUE, BLUELINE AND VANDYKE PRINTS
PHOTOSTAT PRINTS AND SUPPLIES

Associated Architects Printing and Supply Co.

25 PEARL STREET - BOSTON, MASS.

YOUR good is our good. We are here to serve **YOU**
Telephones LIBerty 1277 and 1278, connecting all departments

WRIGHT & POTTER PRINTING COMPANY

COMMERCIAL PRINTERS

32 Derne Street, - - Boston, Mass.

THIS entire building devoted to all kinds of Book, Job and Catalog Printing and Binding

Tel. Haymarket 2000 - 2001 - 2002

Bay State Dredging & Contracting Co.

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
AGC

CONTRACTORS

River and Harbor Improvements, Sea Walls, Breakwaters, Heavy Masonry Construction.

62 Condor Street, East Boston, Mass.

JAMES E. CASHMAN, Treas.
GORHAM H. WHITNEY, Prest. DAVID J. WHITE, Gen. Mgr.

T. Stuart & Son Company

General Contractors

NEWTON, MASSACHUSETTS

THE CRANDALL ENGINEERING COMPANY

CONSULTING AND
CONSTRUCTING ENGINEERS

DESIGN of Floating, Basin, and Railway Dry Docks, Wharves, Piers, Bridges, etc.

CONSTRUCTION of these and other Engineering Structures

102 BORDER STREET
EAST BOSTON, MASS.

STANDARD REFINED MEXICAN ASPHALTS

(SOCONY Brands)

Furnished of required penetration and specifications for construction of Asphalt Macadam and Asphalt Concrete Roads, and for Sheet Asphalt, Asphalt Joint Filler and Bridge Asphalt.

Standard Macadam Asphalt Binder for penetration applied by SOCONY Asphalt Sprayers under pressure, at suitable temperature

QUOTATIONS AND SPECIFICATIONS FURNISHED ON REQUEST

STANDARD OIL CO. OF NEW YORK

NEW ENGLAND DEPARTMENT

Park Sq. Building, 31 St. James Ave., Boston, Mass.

GEO. A. BLAIR L. L. STREET W. O. WELLINGTON

ISAAC BLAIR & CO., Inc., General Contractors

Shoring and Moving Buildings a Specialty

433 Harrison Avenue, BOSTON

STONE & WEBSTER
Incorporated

DESIGN steam power stations, hydro-electric developments, transmission lines, city and interurban railways, gas and chemical plants, industrial plants, warehouses and buildings.

CONSTRUCT either from their own designs or from designs of other engineers or architects.

MANAGE public utility and industrial companies.

REPORT on going concerns, proposed extensions and new projects.

FINANCE industrial and public utility properties and conduct an investment banking business.

NEW YORK BOSTON CHICAGO

WHEN YOU DECIDE ON

GRANITE

FOR

CURBING OR PAVING

YOU SETTLE THE PROBLEM

FOREVER

GRANITE PAVING BLOCK MANUFACTURERS'
ASSOCIATION OF THE U. S., INC,

31 STATE STREET, BOSTON

COMMITTEES

NOMINATING COMMITTEE

Past Presidents (Members of the Committee)

Dugald C. Jackson
Frank M. Gunby
Edwin H. Rogers

John N. Ferguson
Charles R. Main
Arthur D. Weston
(Term expires March, 1929)

Arthur W. Dean
J. Stuart Crandall
Dana M. Wood
(Term expires March, 1930)

SPECIAL COMMITTEES

Program

Charles B. Breed, *Chairman, ex officio*

John B. Babcock, 3d
Henry F. Bryant
Harry A. Hageman
Arthur J. Harty

George A. Sampson
Arthur L. Shaw
Frank B. Walker
Edwin H. Wright

Publication

Harrison P. Eddy, Jr., *Chairman*

John B. Babcock, 3d
Edward S. Larned

Ray H. Lindgren
Waldo F. Pike

Dana M. Wood

Library

John B. Babcock, 3d, *Chairman*

Henry B. Alvord
George G. Bogren

Richard S. Holmgren
Everett N. Hutchins

Legislative Matters

Charles R. Main, *Chairman*

James W. Ingalls

Frank O. Whitney

Subsoils of Boston

Harry E. Sawtell, *Chairman*

Irving B. Crosby
Heywood S. French

Charles D. Kirkpatrick
Charles W. Robinson

Arthur C. Titcomb

Social Activities

George A. Haskins, *Chairman*

Harry L. Barstow
Frank E. Burkett
Herbert G. Davis
Christos Harmantas

A. Malcolm Mager
Arthur M. Pillsbury
Llewellyn T. Schofield
Henry O. Scott

Richard W. Sherman

Membership and Publicity

Miles N. Clair, *Chairman*

Henry B. Alvord
Arthur B. Appleton
James F. Brittain
Samuel W. Brooks

Harold L. Burton
Samson K. Cohen
Edward Grossman
Scott Keith

Eugene Mirabelli

Field and Office
Equipment and Supplies
for the
ENGINEER

New and Used Transits and Levels
Instrument Repairing

BLUE PRINTING—BLACK LINE—BLUE LINE
PHOTOSTATIC PLAN REPRODUCTION
(LARGEST PLANT IN NEW ENGLAND)
Blueprint—PAPER—Drawing

DRAFTING ROOM FURNITURE

B. L. MAKEPEACE, INC.
387 WASHINGTON STREET · 394 BOYLSTON STREET
BOSTON, MASSACHUSETTS